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RESTRICTED

SPECIAL STUDY NO. 58

AIR WEATHER SERVICE

CLIMATOLOGY OF THE ARCTIC REGIONS

PART II

DECEMBER 1946

PUBLICATIONS OF HEADQUARTERS, AIR WEATHER SERVICE

RESTRICTED

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CLIMATOLOGY OF THE ARCTIC REGIONS

PART II

VISIBILITY IN THE ARCTIC

The problem of visibility in the Arctic is extremely complex. The air in the Arctic is very transparent, and the records of many travelers are replete with accounts of the extreme range of visibility. It is not uncommon to see dark mountains one hundred miles distant; similar ranges of visibility are encountered in lower latitudes only over the higher ranges. On the other hand, the lack of contrast, particularly where all surface objects are covered with new snow, results in the inability to distinguish objects close at hand. The traveler may easily fall into a crevasse which he is unable to see in midday. The black nose and claws of a polar bear may be seen clearly before it is possible to see any outline of the animal because the yellowish white of the fur blends with the snow-covered background.

The frequent well-marked temperature inversions of the Arctic region explain the many accounts of mirages. Objects that are known to be below the horizon are not infrequently visible as mirages; and the periods of daytime and twilight are lengthened as the normal index of refraction is altered. The marked inversions may also interfere with the identification of landmarks by distortion and the estimation of vertical distances may be made much more difficult.

The occurrence of various visibility limits for a number of stations in the Russian Arctic are given in figures 66 through 77. The data for these charts were taken from collected synoptic reports for periods varying from one year to six years. The data have been uniformly reduced to 30-day months. Because of the possibility of error in the transmission of the reports and in the method of reduction of the data, the graphs should be construed as showing the general trend of visibility in these regions and should not be accepted as absolute visibility norms.

In winter the lowest visibility is indicated in the vicinity of Cape Chelyuskin. Improved visibility conditions are to be found to the west in the neighborhood of Murmansk and to the east in the neighborhood of Dikson and Amderma. Little variation is indicated in the graphs for interior stations; Irkutsk and Barnaul are examples of stations with poor winter visibility and Archangelsk and Kolyshley, examples of stations with improved conditions. Visibility conditions are better in the spring, particularly over inland stations. The section with the poorest visibility continues to be the Kara Sea. During summer and fall the conditions are better over the inland stations than over the coastal stations. Again, the poorest conditions are to be found in the Kara and eastern Barents Sea regions. The very short record for Franz Joseph Land indicated that visibility conditions are much poorer at Tikhaja Bay in the south than at Rudolph Island in the extreme north.

Limitations to visibility in the Arctic region are primarily fogs, blowing snow, and local smoke. The different types of fogs are considered in the next section. Local smoke is serious only in the vicinity of the large towns, and often occurs with the shallow radiation fogs of winter.

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Blowing snow constitutes a much more serious hazard to flying in the Arctic than in more temperate latitudes. By comparison, the snow is dry and consists of fine particles. It is easily picked up by gentle or moderate winds and is drifted into the hollows, leaving the higher elevations bare. Winds of 9 to 14 m.p.h. will raise the snow a few feet off the ground and the blowing snow will obscure surface objects, such as rocks, runway markers, etc. Winds of 15 m.p.h. or higher will raise the snow to considerable heights, obscuring buildings, radio masts, etc. With high winds all traffic becomes impossible; the driven snow penetrates all types of buildings and the natives remain in their huts until the "urga" as the blizzards are known, have blown over. These storms explain the poor visibility recorded at Cheliuskin in the colder months; the location of this station exposes it to frequent winds of sufficient velocity to cause almost continually blowing snow.

Data for selected stations showing different types of blizzards are shown in table 47. "General" blizzards are those in which snow is falling from clouds as well as being raised up from the surface. Aviation activity is not practicable during these blizzards. "Blowing snow" indicates that the snow is lifted by the winds to appreciable heights (usually 15 m.p.h. or more). Airplanes may fly over areas where blowing snow is in progress, but would be unable to land or take-off. "Drifting snow" indicates that the snow is raised only a few feet and is being drifted. Areas affected by drifting snow may be flown over with safety. Landing or take-off operations may be made but are hazardous under these conditions.

In general, conditions over the Kara and eastern Barents Seas are the poorest from these causes. Conditions are also very poor at Wrangel Island and exposed points along the Chukchi coast. An example of the poor conditions likely to be encountered in the latter area may be seen in the experiences of the Russian aviators assigned to the rescue of the scientific party aboard the "Chelyuskin" which was breaking up in the ice off Wrangel Island. Orders were first issued to take off the passengers on February 15. The first successful flight was not made until March 5. Lyapidevski, perhaps the most successful of the aviators engaged in rescuing members of the "Chelyuskin" party, reported thirty-six unsuccessful attempts at flying the short distance from the coast to the wrecked ship during the rescue operations. On four successive days, March 10 to 13 inclusive, blizzards grounded all airplanes. The data for Wrangel Island, shown in table 47 confirms the experience of the rescue aviators as to the frequency of blizzards of various types in that area.

On the American side of the Arctic, it may be expected that blizzards are equally frequent along the northern coast of Alaska and that they are least frequent over the lower Mackenzie. Over the Canadian Archipelago winds of sufficient velocity may be expected to cause almost continuous conditions of drifting or blowing snow for long periods of time. However, occasionally during this time periods with anticyclonic conditions prevail and the weather generally is bright with very light winds.

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Table 47

Days with Blizzards

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Vaigach													
General	8	7	6	6	4	0	0	0	0	4	7	10	50
Blowing Snow	7	11	9	6	4	0	0	0	0	4	6	6	53
Drifting Snow	16	14	18	15	11	1	0	0	0	6	9	15	105
Yugor Strait													
General	13	11	8	9	6	1	0	0	0	8	13	12	81
Blowing Snow	15	13	9	9	8	0	0	0	0	2	9	10	75
Drifting Snow	9	10	16	9	6	1	0	0	0	3	7	11	72
Domashnii Island													
General	10	4	4	4	3	4	0	0	2	7	4	5	47
Blowing Snow	8	10	5	5	4	2	0	0	0	3	4	7	48
Drifting Snow	5	5	12	12	6	7	0	0	1	5	8	2	67
Great Lakhov Island													
General	4	4	4	3	3	0	0	0	1	3	5	3	30
Blowing Snow	4	3	6	2	3	0	0	0	0	3	4	2	27
Drifting Snow	15	13	16	12	13	2	0	0	3	12	12	13	111
Tiksi Bay													
General	3	4	2	4	2	0	0	0	1	3	2	1	22
Blowing Snow	12	7	4	3	3	0	0	0	0	1	4	5	39
Drifting Snow	16	9	5	5	5	1	0	0	0	3	10	8	62
Wrangel Island													
General	12	9	7	7	4	1	*	*	3	7	10	12	74
Blowing Snow	7	6	6	5	2	0	0	0	2	6	8	4	46
Drifting Snow	9	4	5	5	2	1	0	0	0	1	2	6	35
Cape Otto Schmidt													
General	2	3	4	1	2	0	0	0	2	4	4	4	26
Blowing Snow	5	5	7	3	1	0	0	0	2	4	5	4	36
Drifting Snow	9	7	8	5	4	0	0	0	1	2	6	9	51
Uelen													
General	8	6	8	7	2	1	1	0	1	4	6	5	51
Blowing Snow	4	5	12	5	4	0	2	1	2	3	6	5	47
Drifting Snow	6	5	7	4	2	0	1	1	1	3	4	4	38

* Less than 1 day.

Note: Days with "general" blizzards include those with snow falling from clouds. Days with "blowing" snow include those with blowing snow raised to appreciable heights (usually 15 m.p.h. or more) by winds. Days with "drifting" snow include those with snow raised just off the surface and being blown along with winds (usually between 9 and 14 m.p.h.).

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Conditions during the winter at Fairbanks, Alaska, were analyzed for the years 1939 to 1942 to determine the percentage of observations in which the visibility lowered to a point where instrument flying was made necessary or the airports were closed to all air traffic. The data are summarized in figures 41, 42, and 43. These figures show the percentage of observations for the morning and evening when the flying conditions at Fairbanks were classified as to visibility conditions alone as contact (visibility 3 miles or more), instrument (visibility 1 1/4 to 2 1/2 miles), and closed (visibility 1 mile or less), within 10° F. temperature groups. It is immediately evident that all the visibility measurements in the lowest temperature groups fell either in the instrument or the closed classifications. As the temperatures rose there was a rapid increase in the percentage of observations with contact classifications. The data have been combined as shown in figure 43. It may be stated empirically that when the temperature falls to -45° F. or lower, the visibility in the town of Fairbanks will be very poor. Conversely, when the temperature rises above the freezing point in winter, the visibilities will be uniformly good. It must be understood that these conclusions affect the urban areas only. Visibility conditions may be excellent outside of the city areas with any temperature, particularly along topographic benches where the air drainage is good.

The data have been analyzed further as to the causes of visibilities below 3 miles for all temperatures below 0° F. and for all temperatures above 0° F. The results are shown in figures 41 and 42. It will be noticed that for temperatures below 0° F. the principal cause of low visibility is smoke, while for temperatures above 0° F. smoke does not appear to be a cause of very low visibility. The reason is that calms occur with very low temperatures and the smoke settles over the city, while there is usually appreciable wind with higher temperatures and the smoke is blown away. Furthermore, rising temperatures are frequently a forerunner of cyclonic depressions with the probability of snow and it follows that snow is the principal cause of the poor visibilities in the higher temperature groups. Snow is a very small factor in the lower temperature groups when anticyclonic conditions prevail.

The conditions described above have been alleviated in part by the location of the airport well outside of the city. Smoke is not an important factor at the airport, though probably an increase in the city. Further freedom from delays due to fogs might be obtained if an alternate airport were located on some topographic bench nearby where the air drainage would be sufficient to minimize the occurrence of fog.

Observations of vertical visibility were made at Fairbanks over a period of 7 months. The results are summarized in table 48. Cases when objects on the ground are not visible appear to be fewer in the morning hours than during the afternoon hours. Likewise the cases when the vertical visibility was exceptionally good appear to be more frequent in the afternoon hours than in the morning hours. The condition most frequently encountered from September through March was [illegible] as code 3 - where the [illegible] of [illegible] upon the ground were readily distinguished [illegible] details [illegible] [illegible]

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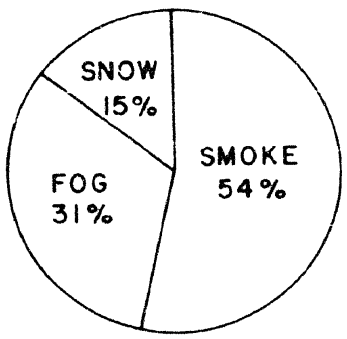
WINTER CONDITIONS, 0830
NOV. '39 - FEB. '42

PERCENTAGE OF OBSERVATIONS

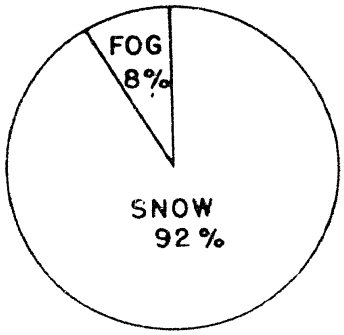
	49 – 40	39 – 30	29 – 20	19 – 10	9 – 0	0 – 9	10 – 19	20 29	30 – 39	40 – 49
C	0	57	87	93	90	92	93	89	100	100
N	33	07	03	03	04	04	04	11	0	0
X	67	36	10	04	06	04	03	0	0	0

BELOW 0°F. ABOVE 0°F.

CAUSES OF VISIBILITY BELOW 3 MILES



BELOW 0°F.



ABOVE 0°F.

2440-2

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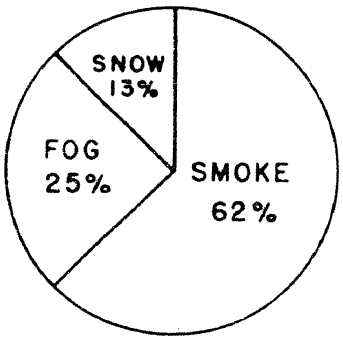
WINTER CONDITIONS, 1430P
JAN. '39-FEB. '42

PERCENTAGE OF OBSERVATIONS

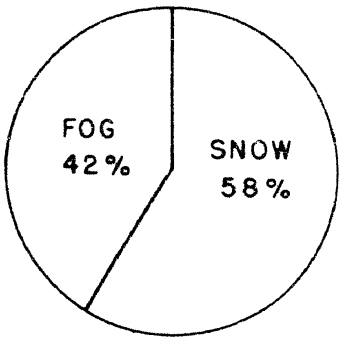
	49-40	39-30	29-20	19-10	9-0	0-9	10-19	20-29	30-39	40-49
C	0	25	78	85	90	95	93	95	100	100
N	0	0	11	7	5	3	03	03	0	0
X	0	75	11	8	5	2	04	0	0	0

BELOW 0° F. ABOVE 0° F.

CAUSES OF VISIBILITY BELOW 3 MILES



BELOW 0° F.



ABOVE 0° F.

2440-1

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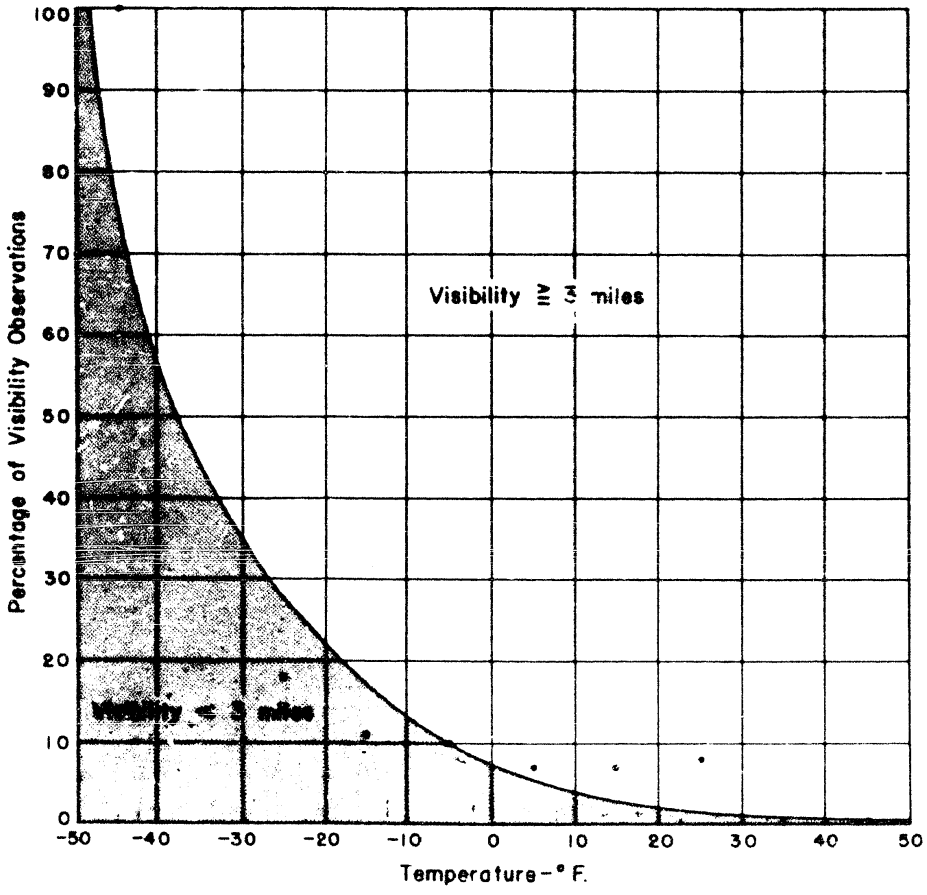

• Fairbanks data – 1939 to 1942

Relation of Temperature to Visibility

2440

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yellow colors were recognized but other colors tended to the same tone. The data are insufficient to draw any conclusions as to seasonal differences in vertical visibility.

Table 48

Vertical Visibility Conditions at Fairbanks

Visibility Code	Jan	Feb	Mar	Sep	Oct	Nov	Dec
Visibility at 5,000 Ft. (%)							
a. m. Observations							
0	3.4	0.0	5.6	10.5	6.5	2.7	0.0
1	10.3	12.5	11.1	0.0	0.0	2.7	3.8
2	17.2	15.6	0.0	15.8	25.8	10.8	11.5
3	34.2	37.5	16.7	36.9	38.7	70.3	65.5
4	27.6	25.0	38.8	26.3	16.1	13.5	19.2
5							
p. m. Observations							
0	0.0	0.0	0.0	0.0	9.5	0.0	0.0
1	0.0	4.2	13.3	0.0	0.0	0.0	0.0
2	17.6	4.2	0.0	28.6	19.0	29.2	15.4
3	53.0	62.5	20.0	35.7	42.9	41.6	80.8
4	17.6	4.1	20.0	14.3	23.8	29.2	3.8
5	11.8	25.0	46.7	21.4	4.8	0.0	0.0
Visibility at 10,000 Ft. (%)							
a. m. Observations							
0	4.3	9.7	26.3	26.3	14.3	7.1	11.5
1	8.7	12.9	5.3	5.3	3.6	0.0	0.0
2	8.7	6.5	0.0	26.3	7.1	14.3	3.8
3	43.5	29.0	10.5	31.5	46.4	57.2	65.5
4	26.1	29.0	15.8	5.3	14.3	21.4	19.2
5	8.7	12.9	42.1	5.3	14.3	0.0	0.0
p. m. Observations							
0	0.0	5.0	6.7	15.4	12.5	0.0	0.0
1	7.7	10.0	20.0	0.0	0.0	0.0	0.0
2	0.0	5.0	0.0	30.8	6.2	5.6	0.0
3	76.9	45.0	13.3	46.1	62.5	83.3	90.9
4	0.0	10.0	13.3	7.7	18.8	11.1	9.1
5	15.4	25.0	46.7	0.0	0.0	0.0	0.0

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Vertical Visibility Conditions at Fairbanks (cont.)

Visibility Code

0 Nothing on the ground visible.
1 Only larger objects on the ground recognized, color distinctions hardly apparent.
2 Details of objects on the ground not visible though outline is apparent. Definite bluish (or brownish) haze veiling all objects through which only reds and yellows stand out.
3 Haze quite apparent, outlines are distinguished but details are not. Colors except reds and yellows tend to the same tone.
4 Details of ground objects easily distinguishable, colors slightly dimmed, haze perceptible when looked for but not otherwise.
5 Ground objects sharp and clear; no sign of haze. (Photographs can be taken on the usual fast films without filters.)

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FOG IN THE ARCTIC REGIONS

In many respects fog is the most important of the weather elements limiting aviation in the Arctic regions. Over a large portion of the Arctic seas, fog may be expected to occur 90 or more days each year, and over small areas it may occur 180 or more days each year. Any analysis of fog in the Arctic is rendered difficult due to the carelessness in defining and recording fog and to the lack of observational reports over large areas. The best material available is from Russian sources for the Kara, Laptev, East Siberian, and Chukchi Seas. The material is contained in a publication, Materials for the Climatology of the Polar Regions of the U. S. S. R., part 7, Leningrad, 1937. Fog data are given for a large number of stations in the area, though for many of the stations the records are very short. In this publication, fog is generally limited by visibilities of 3, 281 feet (1 kilometer) or less (tables 49 to 54, 56 and 58). Data are given for a number of stations in Alaska (table 55). Here dense fog is defined as being limited by visibilities of 1,000 feet or less, while light fog is not defined. Later data for Alaskan stations, given in terms of percentage of observations, defines fog more nearly in accordance with international scale (tables 79 through 94). Even here, however, only the tabulations od dense fog are comparable with other areas, because the tabulations of all fogs include data for light fogs (visibility over 5/8 mile) which are not included in the Russian or European data. Data for Canadian stations are similarly confusing, as the Canadian Meteorological Service followed the lead of the United States. Data for fog (table 56) probably includes "dense" fogs only--visibility less than 1,000 feet in earlier years and less than 660 feet in recent years. Under the heading of "visibility- fog or mist," the Canadian Meterological Service now publishes data for selected stations for the hours of observation only. The visibility limitation for "fog or mist" is 5/8 mile or less; the data therefore, is roughly comparable to that of dense, thick, and moderate fog for other areas but may include other phenomena such as snowstorms, smoke, or haze. (table 57).

Data for Greenland, Iceland, Jan Mayen, Bear Island, Spitsbergen, northern Norway, and northern Finland are taken from various sources where the limitations of fog are not given. In the absence of more definite information it may be assumed that the term "fog" includes the international definitions of dense, thick, and moderate fogs with visibilities of 5/8 mile (1 kilometer) or less.

Still greater uncertainty exists as to the definition and records of data on "mist," Arctic smoke, "spicule fog," or "frost fog." The uncertainty may be illustrated by the fact that during the extensive voyages of the "Maud" accurate observations in which fog and mist were differentiated were made only during the period June 1923 to July 1925. It is for this period that the records of the "Maud" are included in the discussion. It is believed that "frost fog" or "mist" is included in the Russian data, but is not consistently included elsewhere except

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possibly as visibility data. This is strikingly illustrated in the data for the lower Mackenzie Valley, where very few fogs are recorded but where a large percentage of the morning observations in winter show very low visibility described as "mist."

Two types of fog are frequent in the Arctic. The most common type is an advection fog, formed when relatively warm air moves over a cold surface. A further condition is a fairly stable stratification of the air which would limit the increment of visible water vapour to the lowest layers of the atmosphere. Turbulence, whether convective or frontal in nature, is conducive to the formation of clouds but not of fog. The areas where conditions are most favorable for the formation of advection fog in the Arctic are the open waters of the Kara, Laptev, East Siberian, and Chukchi Seas during the summer. Fifteen to twenty days monthly with sea fog during the summer are normal in these areas, twenty to twenty-five days are not uncommon, and in adverse years 30 days with fog may be recorded. The frequency of the summer sea fogs diminishes rapidly from the coast line inland, and diminishes less rapidly over the pack ice. It will be noted from the data that the summer fogs are less frequent over the Barents and Norwegian Seas. This is due to the more turbulent nature of the lower atmosphere over these seas, resulting in less fog and more low clouds. Little is known about the frequency of fogs north of the mainland of North America. It is probable that fog is only slightly less frequent over the Beaufort Sea than over the Chukchi Sea, and that fog north of the Canadian Archipelago and Greenland is comparable to that over the central pack ice. In the summer the advantages of inland terminals over coastal points exposed to the sea fogs may be summed up in stating that fog is three to five times more frequent over the open water of the Arctic than over inland river ports and many times more frequent than over interior highland stations.

Fogs are reported to occur in some localities when a sea breeze carries moist air from the sea over the land. Such a condition must be considered unusual, because the sea breezes are most frequent in summer when the land is much warmer than the ocean, and the turbulence in the cooled air passing over the warm land results in the formation of StCu clouds. However, there are days in the spring and fall when the land could be colder than the open water of the neighboring sea and fogs result from the passage of moist air currents from the sea to land. The area where this type of fog is most likely to occur is the outer islands of the Canadian Archipelago, particularly Prince Patrick, Borden and Meighen Islands, where the prevailing winds are northwest (from sea to land) at all seasons of the year. The fogs do not penetrate far inland, and localities twenty miles from the coast are relatively free of fog. Unlike other areas in the Arctic, the periods of maximum frequency of fog in the outer islands of the Canadian Archipelago would be spring and fall.

The second type of fog of major importance in the Arctic are the radiation fogs of winter. These fogs form readily under an inversion in very cold weather and are caused by the cooling of the lowest layer of air in contact with the ground surface. Cooling by radiation takes place most rapidly over the land areas and least rapidly over open water. The fogs that are formed are generally thin

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and shallow. They occur most frequently along river bottoms where the air drainage is poor and the air movement sluggish. The locale of most frequent occurrence appears to be in the lower Lena River Valley in Siberia, and the lower Mackenzie River Valley in North America. They are also quite frequent in the Yukon Valley and the valleys of the principal northward-flowing rivers of central and eastern Siberia. Radiation fogs are also common over the pack ice during very cold weather

Over the river valleys and over the pack ice, these fogs may be expected from eight to twelve days monthly during the winter. In more adverse years the number of days with radiation fogs may be doubled. In a few localities, such as the lower Mackenzie in the vicinity of Aklavik, early morning radiation fogs may be expected twenty to twenty-five days monthly during the coldest months. It should be stressed that these "frost fogs" do not present as serious an obstacle to aviation as do the "water fogs. They are generally thin fogs; contrasting objects can be distinguished on the surface directly beneath the airplane. It is only in the brief interval when the airplane is passing through the thin fog layer that visibility is seriously reduced. With experience, landings and take-offs can be made with safety through the shallow frost-fogs.

The relative frequency of fog and mist (frost fog) over the pack ice may be inferred from the 2-year data of the "Maud" expedition, as shown in table 49 and in figure 44 (a), (b), and (c) It will be noted that fog is predominantly a summer phenomena, occurring from May through September, while mist is predominantly a winter phenomena, occurring from December through March. At Fairbanks the season in which frost fogs (mist) are to be expected is limited from December through February, but at Aklavik they occur frequently over a longer season from September through April.

Table 49

Frequency of Fog and Mist over Pack Ice

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Maud (2 years' average)													
Fog	4.0	2.0	4.5	2.0	12.5	18.0	24.0	26.5	14.5	4.0	1.5	1.0	114.5
Mist	11.0	6.0	7.5	2.5	3.0	1.0	2.7	0	0	2.0	5.0	9.5	52.2

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OCCURRENCE OF FOG AND MIST ON THE "MAUD"

IN THE PACK ICE, JUNE 1923 TO JULY 1925

APPROXIMATE LOCATION 72° N. X 172° W. TO 70° N. X 162° E.

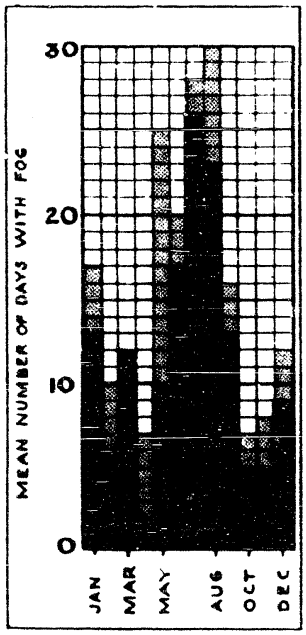

FIG. (a)

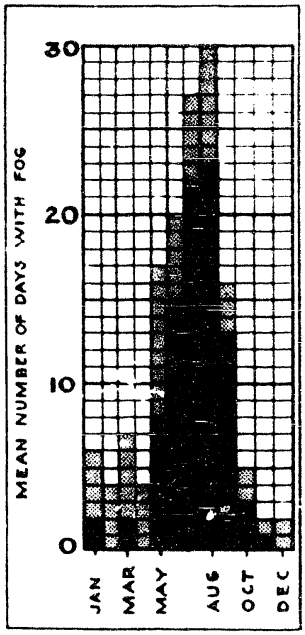

FIG. (b)

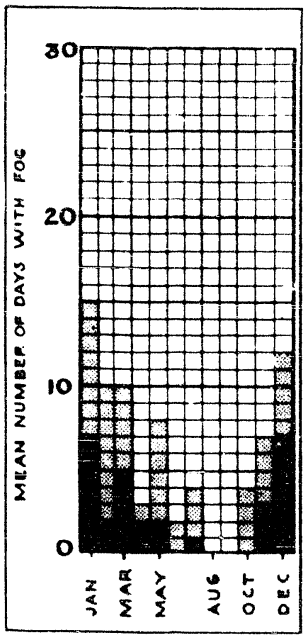

FIG. (c)

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FIGURE

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Of considerable interest but of minor importance is the occurrence of "steam" fogs, also known as Arctic "smoke." They are formed by "steaming" from open water surfaces during extremely cold weather, occurring most frequently over rivers, unfrozen lakes, and open leads or polynias in the Arctic seas. Such "steam" fogs are generally shallow and are quickly dispersed by wind. However, they may at times be sufficiently dense to obscure landing fields adjacent to open water or to obscure landmarks along the airlines. Over the Arctic Ocean they serve the very important purpose of advising the traveler of the presence of open water. They are most noticeable when the temperature contrast between water and air is the greatest, i.e., at extremely low temperatures. In some places "steam" fogs are so frequent during cold weather as to be a natural part of the landscape. For example, Reykjavik, meaning "Smoky Bay," derives its name from the fact that steam fogs arise from the abnormally warm waters of the bay during extremely cold weather.

Similar to the "steam" fogs are the "animal" or "human" fogs of the Arctic region. At temperatures of 50° below zero or lower the moisture given off by an animal is sufficient to cause a light fog in its immediate vicinity. These fogs are evident only in calms or very light winds. They may be sufficiently dense to obscure a herd of reindeer or caribou with the exception of the animals to the windward side. Likewise, only the lead dog of a dog-team may be visible. Light fogs often obscure towns or villages, but there is some question as to the nature of the fog--whether it is caused by smoke, moisture from the habitations, radiation, or some combination of these.

Of special interest is the fact that "fog trails" are left by airplanes when traveling through the very cold atmosphere of Arctic regions. Canadian fliers have reported fog trails 18 miles long in the lower Mackenzie district. Various factors enter into the formation of these fog trails: the amount of condensation nuclei in the exhaust gases; the formation of water vapour in the exhaust gases; the lower pressures set up by the airfoils; and the turbulence set up by the rapidly moving airplane. It is possible for one airplane to follow another by means of fog trail alone.

The distribution of fog as related to temperature is shown in table [illegible], the data for which represent an average of nine stations along the northern Siberian coast between Dickson and Lawrence Bay. The records for the nine stations have been averaged because of the shortness in the periods of records and irregularities in the records of the individual stations. The percentage occurrence of fog for the selected temperature groups follows closely the distribution of temperature, as expected. Thus, in winter the most frequent occurrence of fog is reported in the temperature range -4° to -31° F., while in summer the most frequent occurrence of fog is reported in the temperature range 28° to 41° F. A similar distribution for an inland station (Bulun) shows a wider range of temperature, with the maximum of summer fogs occurring within the temperature range 41° to 58° F. To show the relative frequencies of fog in the winter and in the summer the data in the table for winter, December through March, and for summer, June through September, have been multiplied by the percentage frequency of fog for the same stations. See table [illegible]. The frequencies by temperature groups thus obtained are shown in figure [illegible]. The winter fogs, which are mostly frost fogs, show a maximum frequency in the [illegible] F. interval. The summer fogs, which are mostly [illegible], show a maximum

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The distribution of fog as related to temperature is shown in table 51, the data for which represent an average of nine stations along the northern Siberian coast between Dikson and Lawrence Bay. The records for the nine stations have been averaged because of the shortness in the periods of records and irregularities in the records of the individual stations. The percentage occurrence of fog for the selected temperature groups follows closely the distribution of temperature, as expected. Thus, in winter the most frequent occurrence of fog is reported in the temperature range -4° to -31° F., while in summer the most frequent occurrence of fog is reported in the temperature range 28° to 41° F. A similar distribution for an inland station (Bulun) shows a wider range of temperature, with the maximum of summer fogs occurring within the temperature range 41° to 58° F. To show the relative frequencies of fog in the winter and in the summer the data in the table for winter, December through March, and for summer, June through September, have been multiplied by the percentage frequency of fog for the same stations. (See table 50.) The frequencies by temperature groups thus obtained are shown in figure 45. The winter fogs, which are mostly frost fogs, show a maximum frequency in the -13° to -22° F. interval. The summer fogs, which are mostly advection sea fogs, show a maximum

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frequency in the 32° to 41° F. interval. It should be stressed that the data given do not show probabilities, but only the frequencies of recorded fog. The computation of probabilities was not possible with the data available.

Table 50

Percentage of Fog by Months for Selected Stations

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
14	16	20	22	26	47	56	52	33	14	12	13

Table 51

Percentage Distribution of Fog within Selected Temperature (°F.) Groups

Temperature Range	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-58 to -49												
-49 " -40	6	2										
-40 " -31	9	6	2									
-31 " -22	23	8	7								1	18
-22 " -13	16	17	25	2							4	31
-13 " -4	16	22	39	24						6	23	32
-4 " +5	12	20	21	28						10	30	11
+5 " +14	3	18	5	20	14					15	17	5
+14 " +23	15	4	1	11	25				1	28	7	1
+23 " +28		2		6	40	2			5	20	12	1
+28 " +32		1		4	10	14	2	1	9	11	4	1
+32 " +36				4	7	37	11	10	19	6	2	
+36 " +41				1	4	34	43	40	32	3		
+41 " +50						12	33	31	28			
+50 " +59						1	9	10	5			
							2	2				

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FREQUENCY OF FOG
FOR SELECTED 9° (F.) INTERVALS OF TEMPERATURE

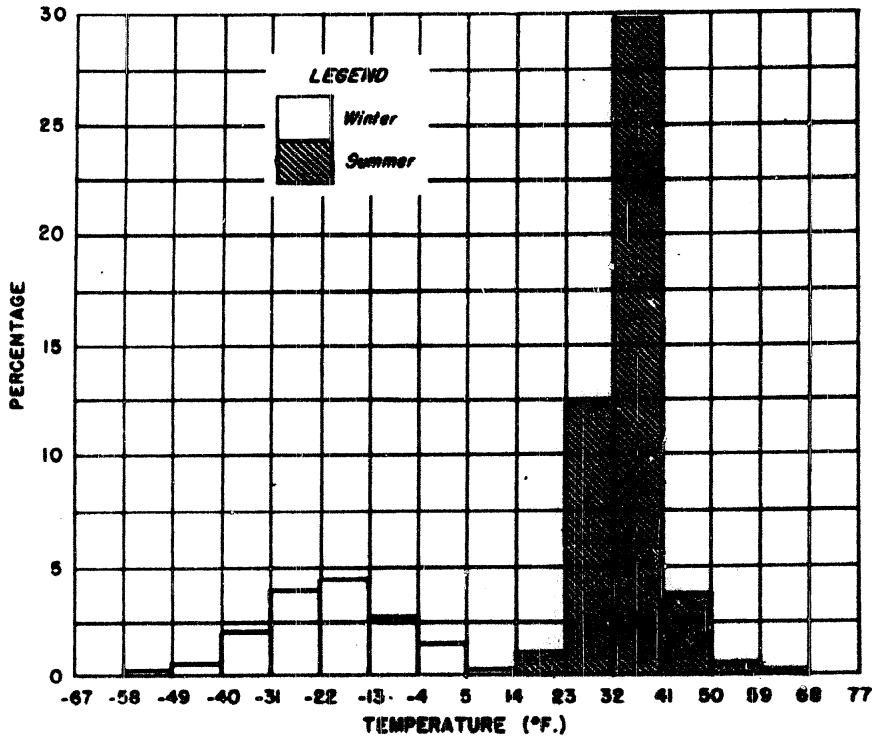

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FIGURE

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The summer sea fogs occur most frequently with easterly winds over the portions of the Arctic north of the Siberian coast. The explanation may be offered that the stable condition necessary for fog formation exists with easterly winds. It was noted from the upper air observations taken on the "Maud" that the temperature inversion aloft existed most frequently with easterly winds and that warm air aloft was carried over the Arctic seas in a southeasterly current. The westerly winds were generally uniformly cold at all levels. These observations are confirmed by the data shown in table 5ℓ. During the summer, fog occurred most frequently at all but two of the stations with winds from the north to east. The two exceptions were the stations on Great Liakhov Island and Bulun. The latter is an interior station and the former showed considerable variability due to the adjacent land masses.

During the fall and winter, the fogs appeared to occur most frequently with south or southwest winds. This would indicate that the stable conditions in which the fog occurs are associated more frequently in this portion of the Arctic region with the great Asiatic anticyclone than with the Polar Anticyclone. However, considerable variability may be expected from year to year with the varying strength of the two anticyclonic systems.

Fogs are not to be expected in summer with offshore winds, as a rule. The offshore winds are generally dry and are not cooled sufficiently to cause the formation of fog. Data are given in the following brief table for Chetyrekhstolbovoi showing that only 13% of the summer fogs occurred with offshore winds while 45% of the summer fogs occurred with winds having a northerly component. As noted above, fogs were most frequent with easterly winds.

Percentage of fogs occurring with different wind directions at Chetyrekhstolbovoi, from June through September, are as follows:

Wind Direction	Calm	NW	N	NE	E	SE	S	SW	W
Percent of Fogs	5	12	10	23	32	6	1	6	5

Summer fogs are most frequent with ligh winds, but may occur with winds of high velocity under favorable conditions. Since they are advection fogs, they do not form readily in calm weather. The opposite is true of the mists or "frost fogs" of the winter season. These latter are radiation fogs and form most readily in calm weather or with very light winds. High winds are very unfavorable for the formation or continuation of fog in the colder months of the year.

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Fogs in the Arctic region are more frequent in the late night and early morning hours than at any other time. In discussing the fogs of the Kara Sea region, Vize has noted that the maximum frequency of fogs occurs at midnight or in the hours immediately following and that the minimum frequency occurs at noon or in the hours immediately following. This agrees closely with experience of the "Maud" in the East Siberian Sea. Figure 46, adapted from the "Scientific Results of the Maud Expedition" shows the probability of fog for July and August throughout the day.

Table 52

Prevailing Wind Direction during Occurrence of Fog

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yrs. Rec.
Vaigach	S	S	S	NE	NE	NE	NE	NE	SW	SW	SW	SE	20
Dickson	S	S	S	S	S	NE	NE	NE	SW	SW	S	S	18
Cape Cheliuskin	S	W	E	W	NE	E	W	E	E	NE	E	W	3
Komsomolsk Island	E	W	NW	W	N	E	NE	SE	E	W	-	-	1
Liakovsky Island	NE	W	NE	NE	NE	E	W	E	W	N	NE	NE	
Tiksi Bay	W	SW	W	NE	E	E	N	E	E	SW	SW	SW	
Bulun	SW	SW	SW	N	N	SW	N	SW	SW	SW	SW	SW	
Chetyrekhstolbovoi						E	NE	E	E				
Otto Schmidt						SE	SE	SE	SE				
Wrangel Island						E	E	E	NE				
Velen						N	N	N	N				
Lawrence Bay						SE	SE	SE	SE				

Data on the diurnal distribution of mist, or frost fogs, are not so conclusive, but indicate a similar distribution to the summer advection fogs. The data from Aklavik indicate that frost fogs are much more frequent in the early morning than at noon or in the evening. It is the common practice in these regions to limit aviation activities to the late morning or afternoon hours. It is particularly important that all flights terminating in the lower Mackenzie, the Yukon or the lower Lena River Valleys during the winter season should be so planned that the flights are completed at midday or in the afternoon.

In table 53, data for glaze and rime ice on surface objects are shown with the total occurrence of fog for varying periods of record. In lines 4 and 5 of the table the probability of glaze or rime ice occurring simultaneously with fog have been computed. The data are given for the summer only for some stations, for the spring, summer, and autumn for others, and for the entire year at a few stations. Although the data are rather sketchy, some

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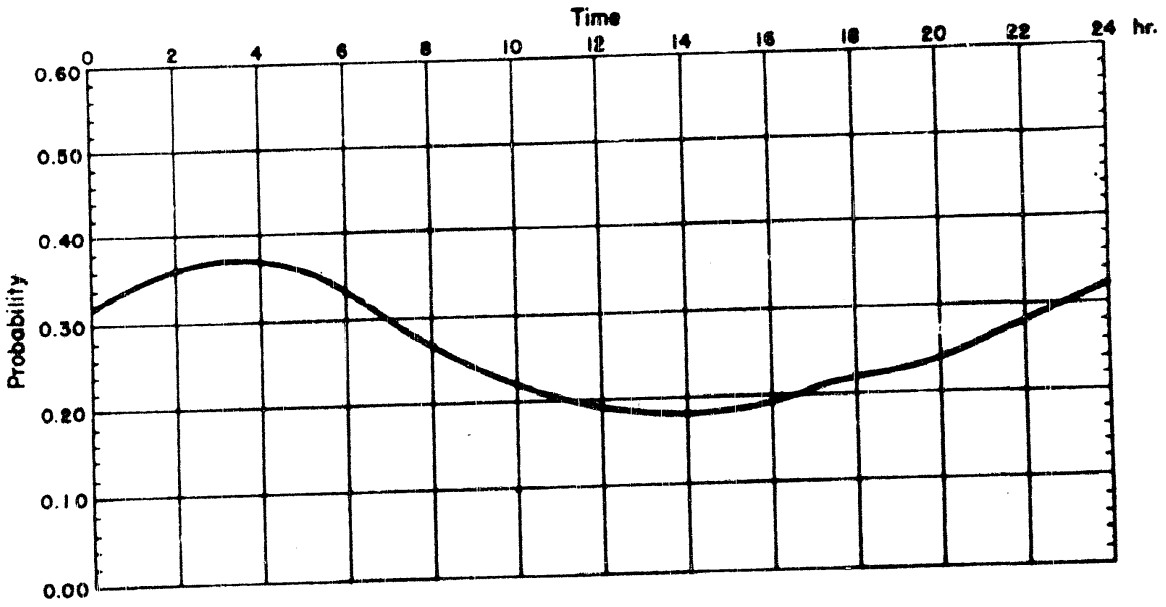

Diurnal Variation of the Probability of Fog

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FIGURE

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conclusions may be drawn. Glaze and rime ice are very frequent over the Arctic seas in the autumn, winter, and spring. It is infrequent in the summer when the surface temperatures are generally above freezing. The data for Bulun indicate that the phenomena are very infrequent over inland areas.

The conditions at Great Liakhov Island are shown in figure 47. These conditions probably approximate the worst conditions to be expected in the Arctic, rather than the average. The graph shows that rime ice is very frequent in the colder months of the year. It is very infrequent during the warmer months of the year from June through September. The maximum occurrence is found in November and December with a secondary maximum in March and April. While the curve shows an opposite trend to that of fog, the probability of rime ice occurring with fog during the colder months is very high in this locality, averaging over 75% from October through April.

Glaze ice does not occur in the coldest months in this locality and is infrequent in the warmest months. The maximum occurrence of glaze is found in autumn, i.e., September and October, with a secondary maximum in June. The temperature relation is evident. Glaze is formed by relatively large water droplets freezing upon a surface whose temperature is lower than 32° F. When the temperature falls below a certain critical point, not evident from the present data, the large water droplets cannot exist in a liquid state, and the formation of glaze ice upon surface objects becomes impossible. On the other hand, rime ice is formed from very small droplets which may exist at much lower temperatures, hence the formation of rime ice at much lower temperatures than are possible for the formation of glaze ice. It has been shown by Malmgren and Sverdrup that the maximum frequency of rime ice (described by them as hoar-frost) probably occurs within the temperature range of -20 to -25° F. and that at lower temperatures, the incidence of rime ice diminishes rapidly. There is a little diurnal variation in the deposits of rime ice in midwinter, but in the fall and spring only negligible deposits are made at midday, the maximum deposits occurring near midnight.

While glaze and rime ice are infrequent in the summer at the surface, it should not be forgotten that temperatures favorable for the formation of ice on aircraft are very frequently encountered aloft. The problem of icing of aircraft in the Arctic is a serious one which has been considered in the section on icing.

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Table 53

Occurrence of Glaze and Rime Ice with Fog

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Vaigach (1924-1934)												
Days with fog	97	105	102	184	204	186	112	56				
Days with glaze	93	7	17	20	9	4	8	7				
Days with rime ice	132	85	41	10	2	2	7	5				
Percentage probability of glaze and fog occurring simultaneously	36	6	10	8	4	2	6	5				
Percentage probability of rime ice and fog occurring simultaneously	63	5	24	5	1	1	-	-				
Yugorski Shar (1924-1934)												
Days with fog	58	84	92	169	184	186	132	91				
Days with glaze	27	1	18	21	11	9	6	12				
Days with rime ice	100	68	35	9	-	4	2	13				
Percentage probability of glaze and fog occurring simultaneously	2	-	6	10	5	3	3	3				
Percentage probability of rime ice and fog occurring simultaneously	57	46	26	5	-	1	2	11				
Dickson Island (1924-1934)												
Days with fog	53	37	38	107	169	140	96	51				
Days with glaze	2	5	7	9	4	4	5	27				
Days with rime ice	71	64	15	7	1	-	3	28				
Percentage probability of glaze and fog occurring simultaneously	4	5	13	6	2	3	2	33				
Percentage probability of rime ice and fog occurring ring simultaneously	43	54	18	5	6	-	3	26				
Novyi Port (1924-1934)												
Days with fog	52	51	47	72	54	64	64	59				
Days with glaze	-	1	-	-	-	-	-	2				
Days with rime ice	48	29	19	3	-	-	-	6				
Percentage probability of glaze and fog occurring simultaneously	-	-	-	-	-	-	-	-				
Percentage probability of rime ice and fog occurring simultaneously	48	35	26	4	-	-	-	7				

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Table 53 (cont.)

Occurrence of Glaze and Rime Ice with Fog (cont.)

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Komsomolsk Pravdy												
Days with fog	4	3	7	14	20	33	33	49	10	5	0	0
Days with glaze	0	0	0	0	1	2	3	9	5	0	0	0
Days with rime ice	0	3	1	8	3	0	0	1	5	6	5	6
Percentage probability of glaze and fog occurring simultaneously	0	0	0	0	5	6	9	14	30	0	0	0
Percentage probability of rime ice and fog occurring simultaneously	0	33	0	43	15	0	0	2	20	20	0	0
Great Liakov Island (1928-1934)												
Days with fog	33	53	55	63	62	89	102	94	32	13	20	41
Days with glaze	0	0	0	0	6	34	12	1	30	37	3	0
Days with rime ice	106	95	120	124	55	8	1	2	6	69	124	129
Percentage probability of glaze and fog occurring simultaneously	0	0	0	0	5	28	10	0	28	31	0	0
Percentage probability of rime ice and fog occurring simultaneously	76	79	75	81	50	8	0	2	9	100	75	83
Tiksi Bay (1932-1934)												
Days with fog	4	9	7	9	9	24	17	12	12	8	1	3
Days with glaze	1	1	0	0	5	2	0	0	1	1	0	0
Days with rime ice	19	16	28	15	9	0	0	0	2	8	6	20
Percentage probability of glaze and fog occurring simultaneously	25	11	0	0	38	0	0	0	0	0	0	0
Percentage probability of rime ice and fog occurring simultaneously	75	67	86	44	22	0	0	0	0	25	0	66
Bulun (1925-1938)												
Days with fog	40	12	15	12	20	29	27	24	50	83	65	54
Days with glaze	0	0	0	0	0	0	0	0	0	0	0	0
Days with rime ice	0	0	0	0	0	0	0	0	0	4	2	5
Percentage probability of glaze and fog occurring simultaneously	0	0	0	0	0	0	0	0	0	0	0	0
Percentage probability of rime ice and fog occurring simultaneously	0	0	0	0	0	0	0	0	0	4	2	6

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Table 53 (cont.)

Occurrence of Glaze and Rime Ice with Fog (cont.)

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Chetyrekhstolbovoi Island												
Days with fog	49	62	46	20								
Days with glaze	17	25	12	9								
Days with rime ice	3	1	1	2								
Percentage probability of glaze and fog occurring simultaneously	27	39	24	10								
Percentage probability of rime ice and fog occurring simultaneously	4	0	2	10								
Cape Otto Schmidt												
Days with fog	53	49	55	36								
Days with glaze	10	3	3	5								
Days with rime ice	18	0	0	3								
Percentage probability of glaze and fog occurring simultaneously	17	6	5	6								
Percentage probability of rime ice and fog occurring simultaneously	13	0	0	8								
Uelen												
Days with fog	108	96	100	84								
Days with glaze	5	0	3	1								
Days with rime ice	2	0	0	5								
Percentage probability of glaze and fog occurring simultaneously	5	0	1	0								
Percentage probability of rime ice and fog occurring simultaneously	2	0	0	2								
Lawrence Bay												
Days with fog	52	81	55	34								
Days with glaze	0	0	0	0								
Days with rime ice	5	0	0	0								
Percentage probability of glaze and fog occurring simultaneously	0	0	0	0								
Percentage probability of rime ice and fog occurring simultaneously	6	0	0	0								

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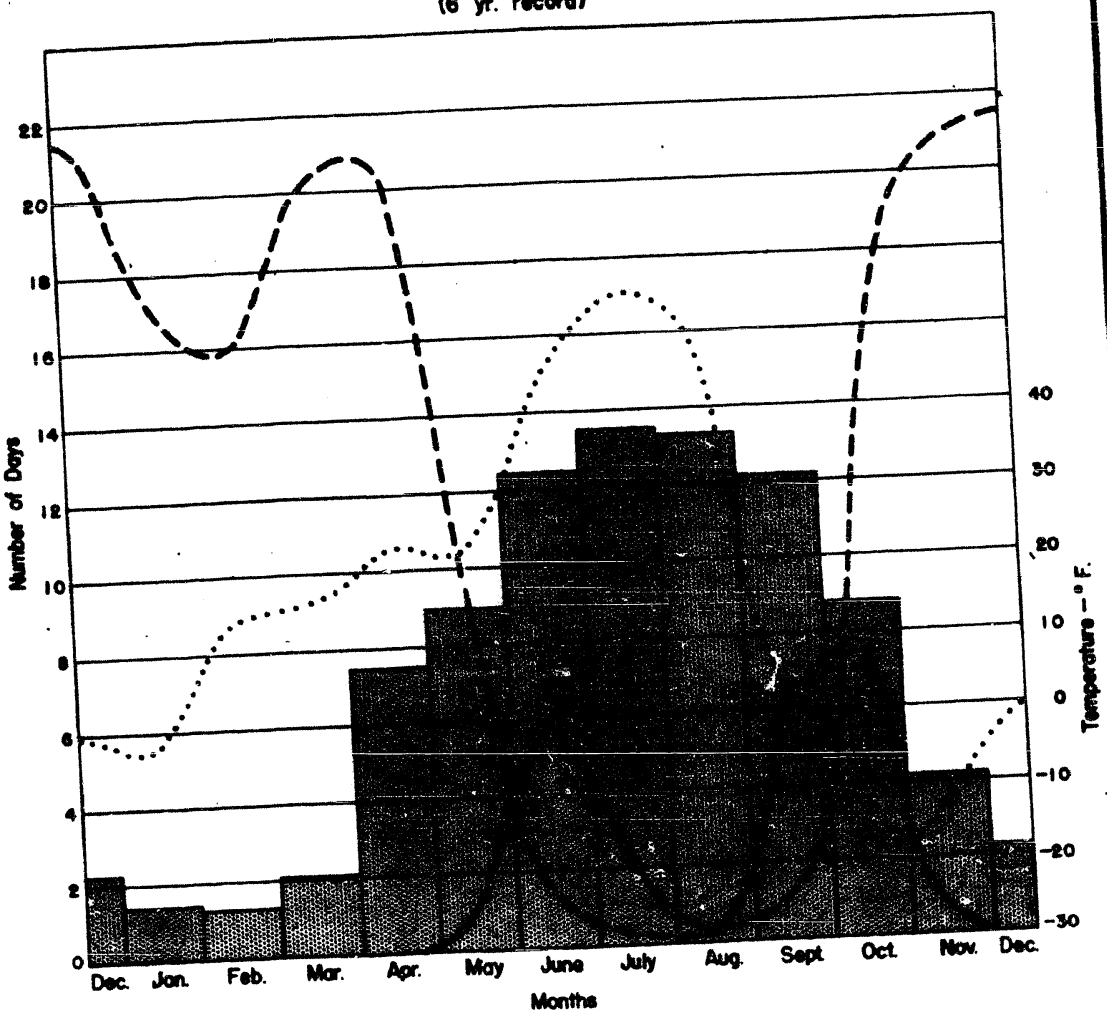
Average Occurrence of Fog, Glaze and Rime Ice on Great Liakhov Island
(6 yr. record)



FIGURE

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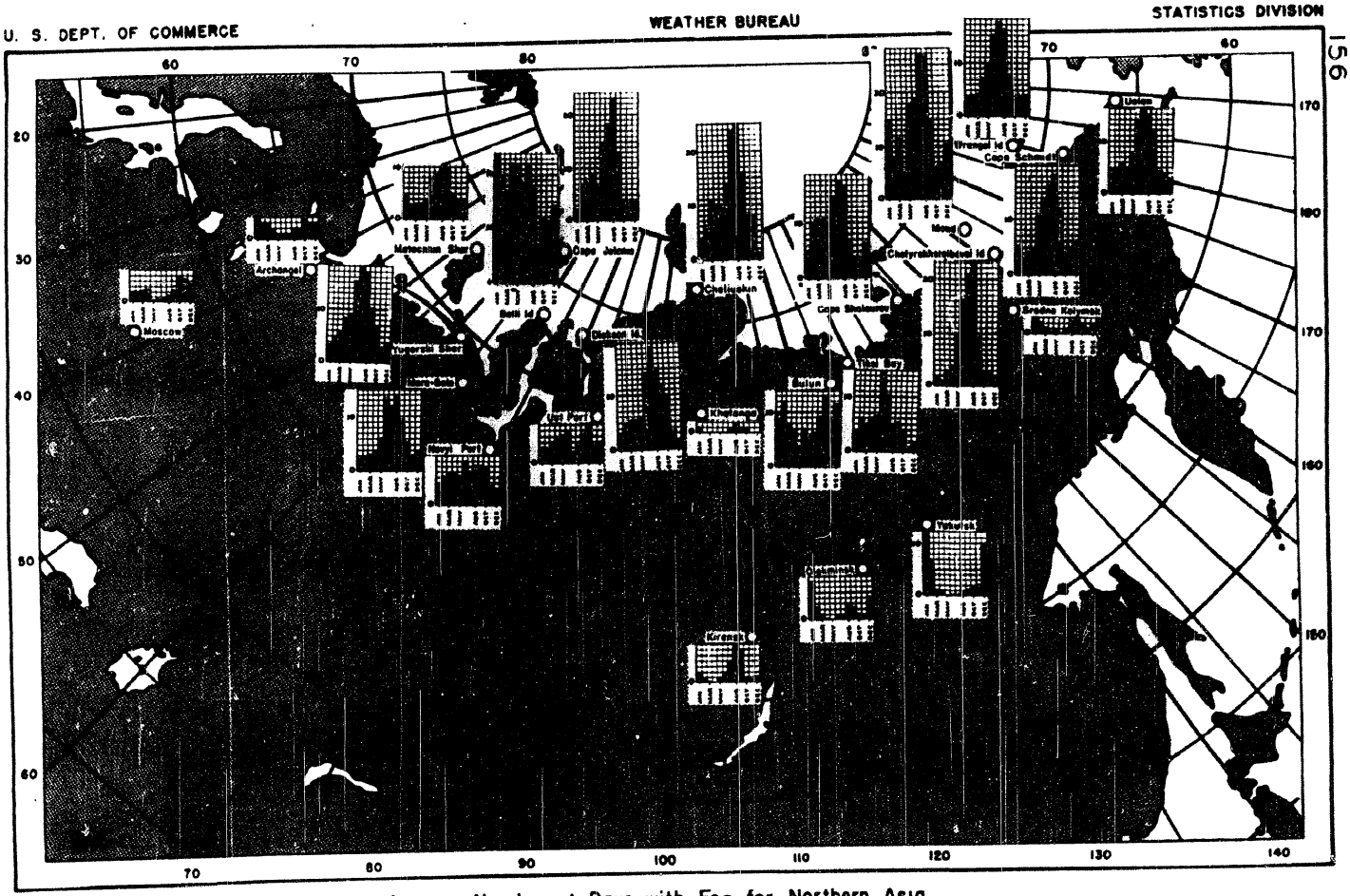

Average Number of Days with Fog for Northern Asia

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Average Number of Days with Fog: U. S. S. R. Arctic Coast*

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Yrs Rec
Matochkin Shar (1925-1934)														
Dense	0.5	0.0	.0.2	0.1	0.0	0.8	1.7	1.3	1.1	0.3	0.2	0.1	6.3	10
Thick	4.7	2.5	1.9	1.7	2.3	6.3	7.1	8.8	7.8	2.9	2.8	3.4	52.2	10
Moderate	0.5	0.5	1.1	0.2	0.9	1.7	1.5	1.7	2.4	2.1	1.1	0.8	14.5	10
Yugorski Shar (1925-1934)														
Dense	0.9	0.6	0.8	1.6	2.7	6.7	8.4	8.9	3.2	1.7	1.2	0.2	36.9	10
Thick	2.8	3.4	4.1	6.0	5.9	9.8	9.5	11.1	8.6	5.6	3.2	3.0	73.0	10
Moderate	0.8	1.8	1.3	1.0	0.5	0.5	1.7	1.8	2.3	1.3	0.1	0.8	13.9	10
Dickson Island (1924-1926) (1928-1934)														
Dense	.0.1	0.3	0.2	0.2	0.3	3.4	4.9	4.3	1.3	1.2	0.1	0.2	16.5	10
Thick	3.0	4.1	4.9	3.7	3.0	8.9	13.2	11.1	7.2	4.6	3.6	1.3	68.6	10
Moderate	2.4	1.3	2.8	2.2	1.6	3.2	4.8	2.4	2.0	1.3	1.5	1.6	27.1	10
Novyi Port (1925-1932)														
Dense	0.4	0.1	0.1	0.2	0.8	2.5	1.0	1.0	1.5	1.0	0.4	0.2	9.2	8
Thick	3.4	2.5	3.0	3.9	4.0	5.6	4.6	4.8	6.1	5.2	2.8	1.6	47.5	8
Moderate	1.9	2.9	3.4	1.9	1.6	1.0	0.4	2.0	1.9	1.5	0.9	1.0	20.4	8
Domashnii Island (1930-1934)														
Dense	0.0	0.8	1.2	0.5	0.2	2.0	4.5	5.2	3.7	1.0	0.0	0.0	19.1	5
Thick	1.2	5.2	5.8	4.0	3.0	3.8	13.5	14.0	9.0	3.0	1.5	0.5	64.5	5
Moderate	0.0	1.8	1.2	3.0	0.5	0.5	4.5	1.8	0.0	0.5	0.0	0.0	13.8	5
Komsomolsk Island (1933-1935)														
Dense	0.0	0.5	0.5	1.0	4.0	6.5	6.5	13.5	5.0	0.5	0.0	0.0	38.0	2
Thick	1.0	1.0	1.5	1.5	5.0	8.5	10.0	8.5	2.0	1.5	0.0	0.0	40.5	2
Moderate	1.0	0.0	2.0	4.0	2.5	4.0	2.5	4.0	3.0	0.5	0.0	0.0	23.5	2
Nordvik Bay														
Dense	0.0	0.0	0.0	0.0	3.0	8.0	7.5	8.0	-	-	0.0	0.0	-	1
Thick	0.0	0.0	4.0	6.0	6.0	7.0	7.0	7.5	-	-	0.0	2.0	-	1
Moderate	2.0	5.0	2.0	5.0	8.0	3.0	2.0	2.0	-	-	2.0	5.0	-	1
Tiksi Bay														
Dense	0.3	0.0	0.0	0.0	0.7	1.7	1.0	0.5	0.3	0.0	0.0	0.0	4.5	3
Thick	1.7	5.7	3.7	5.3	4.3	12.7	8.0	4.0	4.0	2.7	1.0	2.0	55.1	3
Moderate	1.7	1.3	0.7	0.7	0.3	0.3	0.0	0.2	0.3	1.0	0.0	0.0	6.5	3
Bulun														
Dense	2.3	2.3	0.7	1.3	2.0	2.7	0.0	0.3	2.5	7.0	2.2	2.2	25.5	3
Thick	4.0	2.7	1.3	3.0	3.0	5.3	4.0	4.3	7.5	9.0	8.0	6.0	58.1	3
Moderate	9.0	7.7	2.7	3.3	2.3	7.3	3.7	5.0	3.5	6.7	6.0	7.0	64.2	3

* Materials for the Climatology of the Polar Regions, part 7.

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Table 54 (cont.)

Average Number of Days with Fog:
U. S. S. R. Arctic Coast* (cont.)

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Yrs Rec
Cape Shalaurov														
Dense	0.0	0.3	0.7	0.6	0.9	1.7	3.0	3.3	1.2	0.3	0.1	0.0	12.1	7
Thick	2.7	5.6	5.3	4.4	5.7	9.4	11.7	10.7	6.7	3.0	2.3	2.9	70.4	7
Moderate	2.1	3.1	4.6	4.4	2.9	1.9	1.2	1.5	1.2	0.3	1.3	7.1	31.6	7
Chetyrekh - stolbovoi Island														
Dense	0.0	0.0	0.0	0.3	2.0	1.7	2.3	9.5	2.0	0.3	0.3	0.0	18.4	3
Thick	0.7	0.7	1.3	2.3	7.0	12.3	15.0	16.0	9.0	1.7	1.3	1.3	68.6	3
Moderate	1.0	0.0	2.3	2.7	1.7	1.0	5.0	6.5	1.5	1.0	1.3	0.3	24.3	3
Cape Schmidt														
Dense	0.2	0.2	0.2	0.0	1.8	6.0	6.0	6.5	2.2	0.8	1.8	0.2	25.9	4
Thick	3.8	1.5	2.5	3.0	8.8	7.0	11.0	11.0	7.0	1.8	3.5	4.5	65.4	4
Moderate	1.8	1.0	1.2	2.2	1.0	1.2	2.7	4.0	2.0	0.5	0.5	1.0	19.1	4
Wrangel Island														
Dense	0.4	0.0	0.8	1.0	2.0	3.0	3.6	4.8	3.0	0.5	0.8	0.8	20.7	4
Thick	1.0	2.0	1.8	3.2	6.8	12.4	13.6	14.8	6.8	2.0	2.2	0.5	67.1	4
Moderate	0.2	1.0	2.0	2.4	3.4	3.4	4.2	5.8	1.0	1.0	1.8	0.5	25.7	4
Uelen														
Dense	0.1	0.0	0.3	0.3	0.6	3.5	4.3	3.3	1.9	0.9	0.0	0.5	15.7	8
Thick	3.1	3.3	4.4	3.4	4.9	8.6	11.7	10.9	9.1	2.1	3.1	1.6	66.2	8
Moderate	1.0	0.9	1.0	1.0	1.9	3.5	3.7	3.1	3.0	0.6	1.4	1.6	22.7	8
Lawrence Bay														
Dense	0.0	0.0	1.3	0.0	0.2	0.2	2.7	1.2	0.4	0.8	0.0	0.0	6.8	5
Thick	5.0	2.2	2.0	7.0	4.8	7.7	8.2	9.2	7.2	3.8	2.8	6.8	66.7	5
Moderate	0.0	0.0	0.2	0.0	0.2	0.5	0.7	0.0	0.4	1.2	0.0	0.2	3.4	5

* Materials for the Climatology of the Polar Regions, part 7.

Note: Dense Fog Visibility 660 feet to 0 feet
Thick Fog Visibility 1,640 feet to 660 feet
Moderate Fog Visibility 3,281 feet to 1,640 feet.

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Table 39

Average Number of Days with Fog:
Alaska

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Barrow													
Light	2.8	4.5	1.5	2.0	3.0	3.0	5.0	6.0	2.2	2.0	1.5	0.3	33.7
Dense	2.2	5.5	0.8	2.5	4.5	7.0	10.0	10.2	3.2	1.0	1.2	0.8	48.9
Total	5.0	10.0	2.3	4.5	7.5	10.0	15.0	16.2	5.4	3.0	2.7	1.0	82.6
Nome													
Light	4.1	3.6	4.8	3.1	3.9	7.2	6.4	4.9	4.0	3.9	2.6	4.4	52.9
Dense	1.2	1.1	0.4	1.1	1.1	3.4	1.7	0.8	0.4	0.2	0.6	2.3	14.3
Total	5.3	4.7	5.2	4.2	5.0	10.6	8.1	5.7	4.4	4.1	3.2	6.7	67.2
Bethel													
Light	3.7	4.0	3.3	5.6	3.3	1.6	4.7	5.7	5.4	3.6	3.6	5.8	50.3
Dense	1.0	1.7	1.7	0.9	0.7	0.1	0.4	1.2	1.7	0.8	1.2	0.8	12.5
Total	4.7	5.7	5.0	6.5	4.0	1.7	5.1	6.9	7.1	4.4	4.8	6.6	62.8
St. Paul Island													
Light	1.5	1.2	2.5	2.9	3.9	4.8	4.2	9.2	1.9	1.1	1.4	2.0	36.6
Dense	0.2	1.4	0.3	1.4	3.0	2.2	2.8	2.7	0.9	0.6	0.1	0.0	15.6
Total	1.7	2.6	2.8	4.3	6.9	7.0	7.0	12.1	2.8	1.7	1.5	2.0	52.2
Dutch Harbor													
Light	0.5	0.4	0.9	0.0	2.5	3.6	2.8	1.2	1.2	0.9	0.0	0.2	14.2
Dense	0.4	0.8	0.0	0.1	0.0	1.0	0.7	0.3	0.6	0.2	0.0	0.1	4.2
Total	0.9	1.2	0.9	0.1	2.5	4.6	3.5	1.5	1.8	1.1	0.0	0.3	18.4
Anchorage													
Light	5.2	3.5	1.2	1.0	0.3	1.2	1.2	1.2	1.3	1.2	3.3	3.5	24.6
Dense	2.5	0.7	2.0	0.8	0.2	0.0	0.0	0.3	0.7	0.3	1.0	1.7	10.2
Total	7.7	4.2	3.2	1.8	0.5	1.2	1.2	1.5	2.0	1.5	4.3	5.2	34.8
Eagle													
Light	0.9	1.0	0.1	0.0	0.2	0.0	0.3	0.2	0.8	0.1	0.1	1.4	5.1
Dense	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.8
Total	0.9	1.0	0.1	0.0	0.2	0.0	0.3	0.2	1.6	0.1	0.1	1.4	5.9
Fort Yukon													
Light	0.4	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.2	0.6	0.7	3.1
Dense	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1
Total	0.4	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.2	0.7	0.7	3.2
Tanana													
Light	0.3	0.3	0.0	0.0	0.0	0.1	0.2	0.8	0.3	0.2	0.0	0.0	2.2
Dense	0.4	0.8	0.0	0.1	0.0	0.0	0.1	0.5	0.5	0.4	0.1	0.2	3.1
Total	0.7	1.1	0.0	0.1	0.0	0.1	0.3	1.3	0.8	0.6	0.1	0.2	5.3
Fairbanks													
Light	11.3	8.7	1.6	0.7	0.8	0.8	2.0	3.6	3.1	5.6	5.3	5.0	52.5
Dense	5.9	2.8	0.0	0.0	0.0	0.4	0.4	0.4	0.1	0.9	0.8	3.8	15.5
Total	17.2	11.5	11.6	0.7	0.3	1.2	2.4	4.0	3.2	6.5	6.1	12.8	68.0

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Table 56

Average Number of Days with Fog: Arctic Stations

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Yrs Rec
Canada														
Chesterfield	*	1.0	1.0	1.0	2.0	2.0	2.0	3.0	2.0	1.0	1.0	1.0	17.0	10
Churchill	1.0	1.0	*	1.0	1.0	4.0	2.0	2.0	2.0	1.0	*	*	13.0	10
Clark City	*	*	1.0	*	*	1.0	1.0	1.0	1.0	1.0	2.0	0.0	8.0	5
Clyde	4.0	1.0	-	2.0	-	5.0	4.0	10.0	-	2.0	-	-	-	1
Coral Harbour	-	1.0	1.0	2.0	1.0	3.0	3.0	2.0	1.0	2.0	2.0	1.0	-	1
Craig Harbour	*	*	1.0	2.0	0.0	*	2.0	1.0	1.0	1.0	*	1.0	9.0	5
Fort George	1.0	1.0	*	1.0	2.0	2.0	5.0	3.0	1.0	2.0	*	0.0	18.0	7
Great Whale River	1.0	0.0	*	1.0	2.0	6.0	12.0	11.0	3.0	1.0	0.0	*	37.0	5
Lake Harbour	2.0	1.0	1.0	1.0	2.0	4.0	5.0	4.0	2.0	2.0	3.0	3.0	30.0	6
Le Pas	0.0	0.0	1.0	0.0	0.0	0.0	2.0	1.0	1.0	0.0	0.0	0.0	5.0	10
Nottingham	*	1.0	1.0	*	1.0	7.0	8.0	8.0	4.0	1.0	*	0.0	31.0	8
Ottawa	1.0	*	1.0	*	0.0	0.0	0.0	0.0	*	1.0	1.0	1.0	5.0	10
Pangnirtung	1.0	1.0	1.0	1.0	*	1.0	1.0	2.0	1.0	*	0.0	*	9.0	7
Pond Inlet	1.0	1.0	*	1.0	*	1.0	*	2.0	*	1.0	2.0	*	9.0	5
Port Harrison	-	-	-	1.0	4.0	7.0	5.0	7.0	4.0	4.0	-	-	-	1-4
Resolution Island	0.0	0.0	0.0	*	4.0	5.0	9.0	7.0	4.0	*	1.0	1.0	31.0	6
Sherbrooke	2.0	2.0	1.0	*	*	1.0	2.0	6.0	5.0	3.0	1.0	1.0	24.0	2
Winnipeg	1.0	1.0	*	*	*	*	*	*	1.0	1.0	2.0	*	6.0	-
Godhavn	0.0	0.5	0.0	1.0	1.5	4.0	2.5	1.5	0.5	0.5	0.5	1.5	24.0	9
King Point (Yukon)	0.0	1.0	0.0	7.0	6.0	1.0	-	-	5.0	1.0	0.0	1.0	-	1
U. S. S. R.														
Anadyr	1.3	2.0	0.8	1.6	5.6	7.0	2.8	2.2	0.9	1.1	2.0	1.5	28.8	10
Dudinka	1.0	3.5	6.5	6.0	4.5	2.5	3.5	2.0	4.3	7.7	5.7	1.3	48.5	3
Igarka	5.0	4.0	2.0	0.0	1.0	2.0	4.0	3.0	4.0	5.0	2.0	6.0	38.0	4
Kajaani	2.0	2.0	2.0	0.9	0.6	0.1	0.1	1.0	3.0	2.0	2.0	1.0	16.7	35
Kem	1.0	1.0	2.0	1.0	2.0	1.0	2.0	3.0	2.0	2.0	1.0	1.0	19.0	10
Khatanga	1.0	0.0	0.0	0.0	0.0	0.0	0.5	1.5	1.0	1.0	0.0	0.0	5.0	2
Kirensk	1.6	0.4	0.1	0.0	0.5	1.4	3.5	6.8	6.0	0.9	0.4	1.1	22.7	10

* Less than 1 day.

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Table 56 (cont.)

Average Number of Days with Fog: Arctic Stations (cont.)

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Yrs Rec
U. S. S. R. (cont.)														
Kola	0.7	0.3	0.2	0.3	1.0	1.3	3.1	3.8	1.9	0.9	1.6	1.0	16.1	10
Kolguev Island	2.0	3.0	3.0	5.0	6.0	12.0	14.0	12.0	5.0	3.0	4.0	2.0	71.0	7
Leningrad	3.6	3.6	4.4	5.1	2.2	1.3	1.9	7.0	8.1	8.6	5.2	5.4	56.4	10
Malyo Karmakuly	2.0	3.0	2.0	2.0	4.0	8.0	11.0	10.0	7.0	5.0	3.0	2.0	59.0	14
Markovo	0.0	0.0	0.0	0.4	1.3	0.1	0.3	1.2	1.0	0.8	0.1	0.0	5.2	10
Mezen	*	0.0	0.0	*	*	0.0	*	1.0	1.0	1.0	0.0	0.0	3.0	7
Moscow	2.1	2.1	2.3	2.6	0.2	0.5	0.8	1.3	2.3	5.0	4.3	3.5	27.0	10
Nizhne Kolymsk	0.0	0.0	0.0	0.0	1.2	1.4	0.6	1.5	0.8	1.2	0.0	0.2	6.9	5
Obdorsk	0.0	1.0	0.3	0.8	0.7	0.4	1.0	2.2	3.6	3.1	0.4	0.2	15.7	9
Olekminsk	7.0	2.2	1.0	0.1	0.0	0.3	0.9	2.7	2.4	1.1	0.9	4.1	22.7	9
Petsamo	0.4	1.1	0.9	0.2	0.4	1.8	2.2	4.1	1.5	1.5	1.5	0.6	16.2	10
Phoka Bay	6.0	2.0	6.0	13.0	16.0	27.0	21.0	20.0	6.0	5.0	1.0	0.0	126.0	1
Rodchovo	0.0	0.5	0.2	0.0	0.0	0.0	0.7	4.5	2.5	0.5	0.7	0.3	9.9	4
Russkaia Gavan	0.0	0.0	2.0	0.0	2.0	2.0	11.0	3.0	4.0	0.0	0.0	1.0	25.0	1
Russkoe Ustje	0.0	0.0	0.0	0.4	3.0	1.6	0.4	2.0	0.2	1.6	1.8	0.0	11.0	5
Srednc Kolymsk	2.6	2.1	1.1	0.2	0.5	0.1	1.0	2.8	2.4	2.0	1.0	1.5	17.3	8
Tikhaja Bay	4.0	7.0	11.0	20.0	12.0	16.0	20.0	-	-	3.0	5.0	0.0	-	1
Turukhansk	0.2	0.2	0.4	0.0	0.7	0.3	0.3	0.1	0.7	0.7	0.5	1.8	5.7	7
Ust-Maiskaya	0.0	0.0	0.3	0.3	0.4	0.6	1.6	3.1	3.0	0.7	0.0	0.0	10.0	7
Ust Zyrna	0.6	0.7	0.2	0.1	0.6	0.7	1.1	1.4	1.6	1.5	0.9	0.6	10.0	10
Verkhoyansk	3.4	2.6	0.6	0.1	0.6	0.1	1.5	5.0	4.1	1.2	1.8	4.9	25.9	10
Viipuri	2.0	2.0	2.0	2.0	0.7	0.3	0.2	0.8	3.0	3.0	3.0	2.0	21.0	40
Viliuisk	4.3	1.8	1.1	0.1	0.1	0.2	0.1	0.7	1.2	1.0	0.9	4.6	16.1	5
Yakutsk	11.6	6.8	1.1	0.6	0.0	0.1	0.2	0.5	1.2	1.8	2.2	9.4	35.5	9

* less than 1 day.

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Table 56 (cont.)

Average Number of Days with Fog: Arctic Stations (cont.)

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Yrs Rec
Schooner "Eclipse" 75°40' N. x 91° 26' E.	1.0	7.0	3.0	4.0	3.0	4.0	19.0	-	4.0	7.0	1.0	[illegible]		
Yacht "Zaria" 76°08' N. x 95°04' E.	10.0	9.0	16.0	13.0	0.0	0.0	4.0	12.0	-	1.0	4.0	13.0		
Ice-Breaker "Taimyr" 76°40' N. x 100°44' E.	0.0	0.0	0.0	3.0	2.0	8.0	13.0	17.0	-	5.0	0.0	0.0		
Norway														
Trondheim	3.9	3.6	3.2	2.6	2.3	2.4	1.5	2.5	5.0	5.0	6.1	5.3	43.4	15
Tromso	1.0	0.6	0.8	1.0	1.0	1.0	2.0	2.0	2.0	1.0	1.0	0.9	14.0	46
Vardo	0.0	0.0	0.0	0.2	1.0	3.0	6.0	5.0	1.0	0.3	0.0	0.0	16.0	46
Spitzbergen														
Green Harbor	0.1	0.6	0.1	0.1	0.4	3.0	4.0	3.0	1.0	0.7	0.0	0.0	13.0	7
Treurenberg Bay	2.0	5.0	4.0	5.0	3.0	2.0	11.0	3.0	5.0	1.0	1.0	2.0	44.0	9
Jan Mayen	1.9	3.1	3.2	5.4	3.3	6.1	12.8	9.8	5.9	3.1	1.8	1.7	58.3	
Bear Island	1.1	2.5	2.7	5.4	6.7	9.1	18.7	15.3	12.0	3.7	3.3	1.8	82.0	
Iceland														
Grimsey	1.0	1.0	2.0	4.0	7.0	9.0	13.0	9.0	4.0	2.0	1.0	0.4	53.4	
Berufjordur	1.4	1.8	1.3	3.9	7.7	11.4	11.5	9.7	7.0	4.0	2.1	1.2	63.1	
Vestmannaeyjar	3.0	2.0	2.0	5.0	5.0	8.0	7.0	6.0	6.0	4.0	2.0	2.0	52.0	
Stykkisholmur	0.3	0.3	0.3	0.8	1.5	1.5	1.6	1.0	0.7	0.3	0.3	0.4	9.0	

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Table 56 (cont.)

Average Number of Days with Fog: Arctic Stations (cont.)

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Greenland													
Upernivik	2.0	2.0	2.0	4.0	5.0	5.0	11.0	7.0	2.0	1.0	1.0	2.0	47.0
Jakobshavn	9.0	7.0	9.0	11.0	12.0	12.0	11.0	11.0	9.0	9.0	9.0	9.0	113.0
Godhavn	9.0	9.0	11.0	12.0	15.0	15.0	17.0	17.0	5.0	4.0	3.0	5.0	127.0
Holsteinsborg	1.0	1.0	1.0	3.0	4.0	7.0	7.0	7.0	3.0	1.0	1.0	1.0	37.0
Kornok	1.0	0.3	0.4	1.0	2.0	2.0	4.0	4.0	2.0	1.0	1.0	0.3	17.0
Godthaab	1.0	1.0	1.0	3.0	7.0	10.0	13.0	13.0	7.0	2.0	1.0	1.0	61.0
Ivigtut	0.2	0.2	0.4	1.0	2.0	4.0	6.0	7.0	3.0	1.0	1.0	0.2	26.0
Julianehaab	1.0	1.0	2.0	4.0	8.0	11.0	15.0	14.0	9.0	5.0	3.0	1.0	71.0
Narsarssuak	0.3	1.0	1.0	2.0	7.0	10.0	15.0	13.0	7.0	3.0	1.0	0.4	60.0
Angmagssalik	1.0	1.0	1.0	3.0	7.0	9.0	9.0	8.0	4.0	3.0	2.0	0.4	48.0
Scoresbysund	3.0	7.0	5.0	9.0	13.0	16.0	10.0	10.0	10.0	4.0	3.0	3.0	98.0
Myggbukta	6.0	1.0	1.0	1.0	2.0	6.0	6.0	7.0	4.0	0.0	-	-	28.0

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Table 57

Number of Days with Very Low Visibility

(Fog and Mist) at Canadian Stations

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Yrs Rec
WESTERN CANADA														
Edmonton	0.6	0.3	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.3	0.6	0.0	2.7	3-4
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Whitehorse	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	3.1	5.5	1
Hudson Hope	21.7	19.6	21.4	13.8	0.6	4.5	2.5	4.0	5.1	17.0	20.1	22.3		1-3
	4.3	2.2	2.5	0.6	0.0	1.5	0.6	1.9	1.8	0.9	4.5	4.0		
Mayo Landing	6.5	8.4	0.6	0.6	0.6	0.0	0.6	1.9	3.6	5.3	5.1	7.8	41.0	1-4
	6.2	2.0	1.2	0.3	0.0	0.0	0.0	1.6	0.6	4.0	3.6	10.5	30.0	
Dawson	5.3	7.6	3.1	3.9	6.2	4.8	4.0	0.6	0.6	2.5	2.4	8.7	49.7	3-4
	5.6	5.3	3.1	3.9	8.4	6.6	6.8	0.0	0.0	0.6	1.5	6.8	48.6	
Medicine Hat	1.2	2.0	1.6	0.0	0.3	0.0	0.0	0.0	0.6	0.9	0.9	0.6	8.1	3-4
	0.0	0.8	0.9	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.0	0.3	3.6	
Keg River	1.9	1.4	0.6	0.6	0.9	0.6	0.6	0.6	3.6	0.0	3.9	3.1	17.8	---
	1.6	0.3	1.9	0.0	0.0	0.0	0.6	0.0	0.3	0.3	3.0	1.2	9.2	
Ft. Nelson	0.0	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.3	0.6	0.9	0.6	3.0	3
Ft. McMurray	0.6	0.3	1.2	0.6	0.3	0.6	1.9	5.3	3.6	1.6	1.2	0.6	17.8	3-4
	0.6	0.3	0.6	0.6	0.3	0.0	0.3	0.0	0.3	0.6	0.9	0.3	4.8	
Ft. Smith	0.9	0.6	2.5	0.6	0.0	0.0	0.0	0.9	0.0	0.0	8.1	3.1	16.7	---
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	3.0	4.0	7.9	
Ft. Simpson	1.6	0.0	0.0	0.9	0.0	0.9	0.0	1.9	5.4	0.9	6.6	0.0	13.2	3-4
	0.9	1.1	0.0	0.6	0.0	0.9	0.0	1.9	0.6	1.9	1.5	3.1	12.5	
Ft. Norman	16.7	14.0	10.2	7.2	1.9	3.9	7.1	2.5	13.8	15.5	14.7	14.6	122.1	3-4
	10.5	7.6	8.7	12.3	0.0	3.6	5.0	5.3	0.6	6.5	6.3	4.3	70.7	
Beaver Lodge	0.6	0.0	10.2	0.6	0.0	0.0	0.0	1.6	0.9	0.0	0.9	0.6	15.4	2-3
	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.9	2.1	
Watson Lake	0.3	1.2	0.3	0.0	0.0	0.0	0.3	0.0	1.9	2.8	1.9	3.1	11.8	3
Aklavik	19.6	21.6	27.6	12.3	2.0	1.7	2.2	2.5	21.2	19.7	15.6	19.6	165.6	3-5

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Table 57 (cont.)

Number of Days with Very Low Visibility
(Fog and Mist) at Canadian Stations (cont.)

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Yrs Rec
WESTERN CANADA (cont.)														
Aklavik (cont.)	8.0	1.0	2.0	0.0	0.0	0.0	0.0	0.0	2.0	3.0	1.0	1.0	18.0	1
	6.6	2.0	2.2	0.8	0.0	0.2	0.3	1.2	1.7	1.5	1.5	7.5	25.5	5-7
Coppermine	7.0	4.0	2.2	2.6	4.0	1.2	1.4	2.0	1.4	0.4	0.8	3.8	30.8	4-5
	6.0	2.5	1.5	2.2	1.6	0.2	0.6	0.8	1.2	0.2	0.5	5.0	22.3	
EASTERN CANADA														
Chesterfield	0.6	1.1	2.2	1.2	0.6	*	0.6	0.3	0.9	0.6	0.0	0.3		3
	0.3	1.1	2.2	0.6	0.6	*	0.6	0.6	0.9	0.6	0.0	0.3		
Churchill	0.6	0.6	0.9	0.6	0.6	0.6	0.3	0.3	0.3	0.3	0.3	0.3		3
	0.6	0.6	0.9	0.6	0.3	0.3	0.0	0.3	0.0	0.3	0.3	0.6		
Coral Harbour	0.0	1.4	1.2	0.9	0.6	1.8	-	-	-	-	-	-	-	1/2
	0.3	0.9	1.7	0.6	0.0	0.0	-	-	-	-	-	-	-	1/2
Craig Harbour	1.6	0.8	1.2	0.9	0.3	1.2	0.3	0.3	0.6	0.6	1.8	2.2		3
	1.2	1.7	1.2	0.9	0.3	0.8	0.3	0.3	0.6	1.2	2.4	2.8		
Le Pas	1.2	0.9	0.9	0.3	0.6	0.6	0.3	1.2	0.9	0.9	0.3	0.9		3
	1.6	0.6	1.2	0.3	0.3	0.6	0.3	0.3	0.3	0.9	1.2	0.9		
Nottingham	2.2	0.8	0.9	1.2	0.6	0.6	0.9	1.6	0.6	1.9	3.0	2.2		3
	2.5	1.4	0.9	1.2	0.6	0.9	0.9	1.6	0.9	1.2	3.3	1.9		
Pond Inlet	0.6	1.4	0.3	*	*	*	*	0.3	0.0	0.3	0.6	1.2		3
	1.6	3.1	2.2	0.3	0.3	*	0.0	*	0.0	2.2	0.3	1.2		
Resolution Island	0.9	0.6	0.6	0.6	0.9	1.8	2.8	1.9	0.6	0.3	1.2	0.3		3
	*	0.6	0.6	0.6	1.2	1.8	1.6	1.9	0.6	0.9	1.2	0.6		

* Less than 0.1 day.

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Table 58

Maximum, Minimum and Average Number of Days with Fog: U.S.S.R.

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Archangel (20 yrs.)													
Maximum	8	7	6	5	2	3	4	13	6	10	10	8	52
Minimum	0	0	1	0	0	0	0	0	1	0	1	0	17
Average	4.0	3.0	3.0	2.0	1.0	1.0	1.0	2.0	2.0	4.0	3.0	3.0	29.0
Cape Zhelaniia (4 yrs.)													
Maximum	6	17	16	19	11	16	24	29	17	6	2	6	144
Minimum	0	2	3	4	4	14	13	18	10	1	0	0	93
Average	2.2	6.8	7.2	8.5	6.2	14.5	18.2	23.0	13.0	4.0	1.2	2.5	107.3
Matochkin Shar (12 yrs.)													
Maximum	19	6	7	12	10	15	15	14	17	15	14	14	108
Minimum	0	0	0	0	0	3	1	3	4	0	0	1	27
Average	4.7	2.9	3.1	3.1	3.5	7.9	8.5	9.9	9.6	4.9	3.6	3.9	65.6
Vaigach Island (18 yrs.)													
Maximum	15	22	19	21	17	22	26	28	23	19	11	11	188
Minimum	0	0	0	2	3	10	9	3	1	1	0	0	72
Average	5.8	7.2	9.0	9.9	10.2	16.3	18.5	18.9	12.3	6.7	4.2	4.9	123.9
Yugorski Shar (22 yrs.)													
Maximum	9	18	17	18	21	20	23	21	23	13	9	11	169
Minimum	0	0	0	1	2	8	10	7	1	1	0	0	74
Average	3.5	5.0	5.6	8.3	9.1	15.2	17.5	16.6	10.2	6.5	3.1	3.5	104.1
Mare Sale (16 yrs.)													
Maximum	11	11	14	10	22	23	18	22	16	14	11	12	148
Minimum	0	0	0	0	1	3	5	7	1	0	0	0	39
Average	2.5	2.8	3.2	3.6	6.1	13.4	11.9	13.9	9.4	5.3	3.0	3.4	78.5
Komsomolsk Pravdy Island (2 yrs.)													
Maximum	4	2	4	9	11	17	17	27	-	3	0	0	-
Minimum	0	1	3	5	9	16	16	22	-	2	0	0	-
Average	2.0	1.5	3.5	7.0	10.0	16.5	16.5	24.5	10.0	2.5	0.0	0.0	94.1
Pronchishchev Bay (less than 1 yr.)													
	6	13	8	12	8	9	15	16	-	-	9	9	-
Preobrazhenia Island (less than 1 yr.)													
	10	7	1	8	8	12	11	-	-	9	8	4	-
Nordvik Bay - North Shore													
1934						11	15	20	-	-	8	4	-
1935	2	6	4	14	16	19	14	12	-	-	-	-	-
Nordvik Bay - South Shore													
1932								18	4	3	1	0	-
1933	0	0	1	3	3	5	12	7	-	-	-	-	-
Mastyr Island (less than 1 yr.)													
	4	2	1	5	13	11	10	4	-	1	6	9	-
Dunai Island (less than 1 yr.)													
	-	-	-	2	1	15	17	24	-	-	-	-	-

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Table 58 (cont.)

Maximum, Minimum and Average Number of Days with Fog: U.S.S.R. (cont.)

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Belii Island (2 yrs.)													
Maximum	29	20	23	26	22	19	26	21	8	15	13	24	228
Minimum	19	20	11	18	21	18	17	14	6	8	10	8	176
Average	24.0	20.0	17.0	22.0	21.5	18.5	21.5	17.5	7.0	11.5	11.3	14.3	206.1
Novyi Port (9 yrs.)													
Maximum	8	14	13	12	9	12	10	12	16	11	9	5	91
Minimum	0	0	1	1	1	3	1	3	1	1	0	0	44
Average	3.9	5.1	5.8	5.7	5.2	8.0	6.0	7.1	7.1	6.6	3.8	2.6	66.9
Ust Yenesei Port (14 yrs.)													
Maximum	9	8	11	16	12	14	8	8	15	14	17	18	89
Minimum	0	0	0	0	0	0	0	1	3	2	0	0	27
Average	3.1	2.7	3.8	4.8	5.1	5.7	2.3	3.4	5.4	6.6	3.7	3.9	50.5
Dickson Island (16 yrs.)													
Maximum	9	22	15	14	14	22	26	21	15	12	17	11	113
Minimum	0	0	0	1	0	5	10	6	5	0	0	0	65
Average	3.1	4.5	5.2	5.3	5.9	14.1	19.3	14.9	11.5	4.5	3.3	1.6	93.2
Cape Cheliuskin (3 yrs.)													
Maximum	9	10	14	13	13	16	28	28	16	13	12	3	
Minimum	0	1	9	7	7	10	20	21	15	4	1	0	
Average	3.7	6.0	10.7	10.0	9.3	14.0	23.7	24.7	15.5	8.3	7.7	1.3	134.9
Domashnii Island (4 yrs.)													
Maximum	5	16	11	15	6	9	27	21	20	8	6	2	95
Minimum	0	3	3	3	0	2	15	18	8	2	0	0	88
Average	1.2	7.2	8.0	8.5	3.5	5.8	21.2	19.8	12.8	4.5	1.5	0.5	94.0
Mapousy Island (less than 1 yr.)													
	4	9	18	9	6	3	11	-	1	12	6	11	-
Tiksi Bay (3 yrs.)													
Maximum	8	9	7	9	10	20	14	8	8	4	1	3	67
Minimum	0	1	0	1	4	11	8	1	4	3	0	0	47
Average	4.0	6.0	4.7	6.0	6.3	14.7	10.3	5.0	5.3	3.7	0.7	1.7	68.4
Bulun (8 yrs.)													
Maximum	17	22	18	11	10	15	11	11	16	25	20	23	152
Minimum	2	1	0	1	0	0	1	0	0	1	0	1	20
Average	10.0	11.8	7.4	6.3	4.0	6.9	5.6	6.2	9.1	12.9	8.8	11.4	100.4
Cape Shalaurov (Great Liakov Island) (7 yrs.)													
Maximum	9	17	20	14	16	24	22	20	9	8	5	12	136
Minimum	2	4	2	6	6	6	10	12	3	2	2	1	95
Average	5.1	10.0	10.7	10.4	9.7	14.7	17.4	16.3	6.3	3.5	3.4	6.3	113.8
Chetyrekhstolbovoi Island (3 yrs.)													
Maximum	4	2	8	4	14	19	25	24	10	4	6	4	98
Minimum	0	0	0	3	7	14	17	22	10	0	0	0	95
Average	1.7	0.7	2.7	3.3	10.0	16.3	20.7	23.0	10.0	2.7	2.3	2.0	95.4

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Table 58 (cont.)

Maximum, Minimum and Average Number of Days with Fog: U.S.S.R. (cont.)

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Cape Shelagski (2 yrs.)													
Maximum	2	2	6	6	13	28	21	-	15	3	3	3	-
Minimum	0	1	2	3	10	14	13	-	8	2	3	2	-
Average	1.0	1.5	4.0	4.5	11.5	21.0	17.0	20.0	11.5	2.5	3.0	2.5	100.0
Cape Otto Schmidt (4 yrs.)													
Maximum	14	9	12	15	14	19	18	23	14	7	7	12	148
Minimum	0	0	0	0	7	10	14	14	10	1	1	0	76
Average	5.2	2.5	4.2	4.5	10.5	13.2	16.3	18.3	12.0	3.2	4.8	5.5	100.2
Wrangel Island (10 yrs.)													
Maximum	7	7	7	15	19	20	21	21	15	11	13	13	123
Minimum	0	0	0	1	3	8	10	10	2	0	0	0	87
Average	3.6	3.9	4.2	7.1	9.7	15.2	17.4	16.2	7.6	3.6	3.8	4.1	96.4
Uelen (8 yrs.)													
Maximum	10	11	15	10	16	22	24	24	16	7	10	8	133
Minimum	0	1	0	1	2	5	8	6	3	0	0	0	51
Average	4.8	4.5	5.5	4.8	7.0	13.5	16.0	14.3	12.0	4.1	3.9	3.0	94.4
Lawrence Bay (4 yrs.)													
Maximum	14	9	14	15	12	16	23	17	12	16	5	14	114
Minimum	3	0	5	4	1	5	11	10	5	2	1	4	90
Average	7.0	4.0	8.2	9.2	5.8	10.4	16.2	13.8	8.5	6.2	2.5	9.0	100.8
"Maud" (2 yrs.)													
Maximum	17	10	12	7	25	20	28	30	16	7	8	12	-
Minimum	13	6	12	2	10	17	26	23	13	5	5	9	-
Average	15.0	8.0	12.0	4.5	17.5	19.0	26.7	26.5	14.5	6.0	6.5	10.5	166.7

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ILLUMINATION

The problem of illumination in the Arctic is a peculiarly complex one, and only the more important aspects of the problem will be mentioned here. The possible hours of sunshine for different latitudes below and above the Arctic Circle are shown in figure 50. It will be seen that the seasonal change becomes very marked in the higher latitudes. The long hours of sunshine compensate in part for the shorter summer season. Where soil conditions permit, it is possible to grow many vegetables and flowering plants near the Arctic Circle. The data are presented in a different form in figure 49. Here the area having 24 hours of sunshine is shown by the lightest shading (E). At 70° N. the period with 24 hours of sunshine lasts approximately 2 months. At 80° N. the period with 24 hours sunshine lasts approximately 4 and 1/3 months, while at the Pole it lasts approximately half of the year. The total number of possible hours of sunshine at the Pole exceeds the possible hours of sunshine at the Equator.

The conditions of light are in some ways more important than the duration of sunlight or darkness. The periods of twilight are longer in high latitudes than in low latitudes and many types of operations can be carried out under twilight conditions. In figure 49 the seasonal distribution of twilight is shown together with the periods of sunshine and darkness. Civil twilight is computed from the time that the sun is 6° below the horizon to the time of sunrise or sunset. Ordinary outdoor activities can be carried on under conditions of civil twilight. Astronomical twilight is computed from the time the sun is 18° below the horizon, to the time of beginning or ending of civil twilight. Under Arctic conditions many activities that would be impossible in lower latitudes may be carried on under astronomical twilight.

In the Arctic the amount of light reflected from the snow-covered surfaces is much greater than the amount of light reflected from the darker surfaces of middle and lower latitudes. The albedo over a new snow field may be 90% or ever higher as contrasted to 10 or 15% over plowed fields and even less over areas with growing vegetation. There are two important results. The useful illumination is much greater than from the equal sources in lower latitudes. So much light is reflected from the surface that shadows may be nearly obliterated. The lack of contrast results under certain conditions in an inability to distinguish outlines of the terrain or objects even at very short distances. In the distance the landscape and sky merge into a featureless grayish-white field. Dark mountains which furnish their own contrast with the snow-covered landscape may be seen for very great distances while the crevasse immediately ahead of the traveler may be unseen due to lack of contrast. Moreover, because of the high reflectivity of the snow cover, sunburn may be more serious in the Arctic than in lower latitudes. Dark glasses are a necessary part of the equipment of every Arctic traveler, and dark veils are sometimes worn.

In the winter the high reflectivity of the snow cover is a valuable asset. The light coming from the moon, stars, and auroras is made much more effective. Aviators have reported that the light of a half moon over a snow-covered field is sufficient for landing purposes; indeed, it is

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better than sunlight over the same field because the effects of glare have been eliminated. It is possible to read a newspaper under a full moon in the Arctic. The light of the stars is sufficient for travel purposes. The light of the aurorae is in certain areas sufficiently strong and frequent enough to be dependable. The heavy circle in figure 53 shows the belt of maximum frequency of aurorae in the Arctic region. It is only in periods of heavy overcast that the degree of darkness in the Arctic region begins to approach the degree of darkness in the temperate latitudes.

Considerable research will be necessary before it will be possible to state the actual amount of illumination available in different sectors of the Arctic. Such research is now being carried on by the U.S.S.R. at selected Arctic stations and by the United States Weather Bureau. Until the results of the research are made available the following generalizations may be made as to light conditions in the Arctic:

The total illumination is greatest over snow-covered areas. The areas of maximum illumination would be found over the permanent ice-pack of the central Arctic regions and over the snow-covered highlands of Greenland. The areas of least illumination would be found over open water areas in winter and over snow-free land areas in summer.

Sufficient illumination exists for the carrying on of minimum operations at all times except under heavy overcasts. Heavy overcasts are to be expected only in storms or in the vicinity of the Arctic Front. Furthermore, sufficient illumination exists for the carrying on of all ordinary operations usually performed in the open (equivalent to the ability of being able to read a newspaper without artificial light) at all seasons of the year under a full moon.

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DISTRIBUTION OF ILLUMINATION IN THE NORTH POLAR REGION.

Months are given by Roman numerals, degrees of latitude by Arabic numerals on the left. Civil twilight lasts until sun sinks 6° below the horizon, astronomical twilight lasts until sun sinks 18° below the horizon.

A Completely dark.

B_1 Dark night with Astronomical twilight at midday.

B_2 Dark night with Civil twilight at midday.

C Twilight day and night.

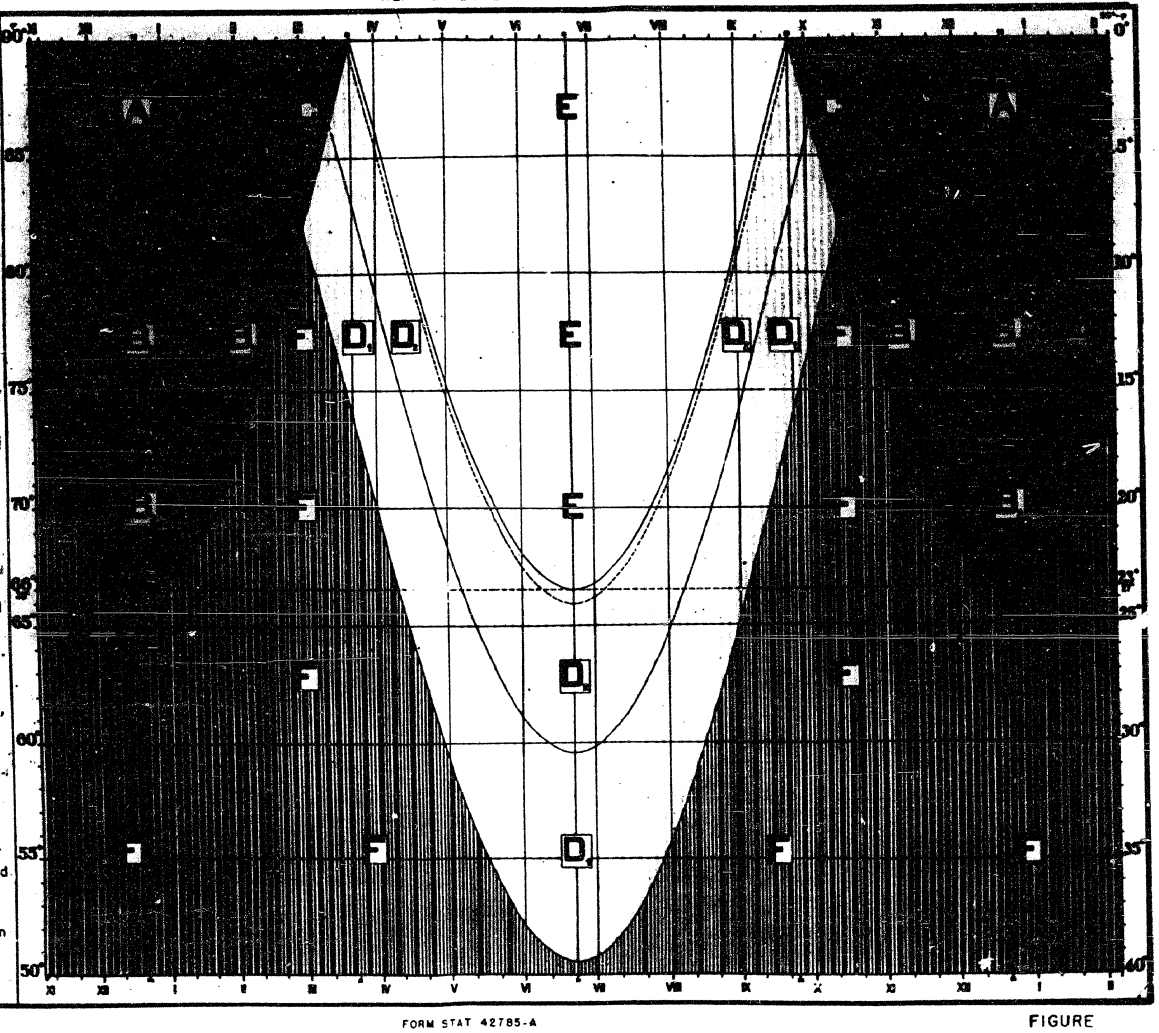
D_1 Light night resulting from astronomical twilight, with synchronous change from day to night.

D_2 Light night resulting from civil twilight, with synchronous change from day to night.

E Completely light.

F Regular alternation between day and night.

Effect of refraction between B_2 and E.



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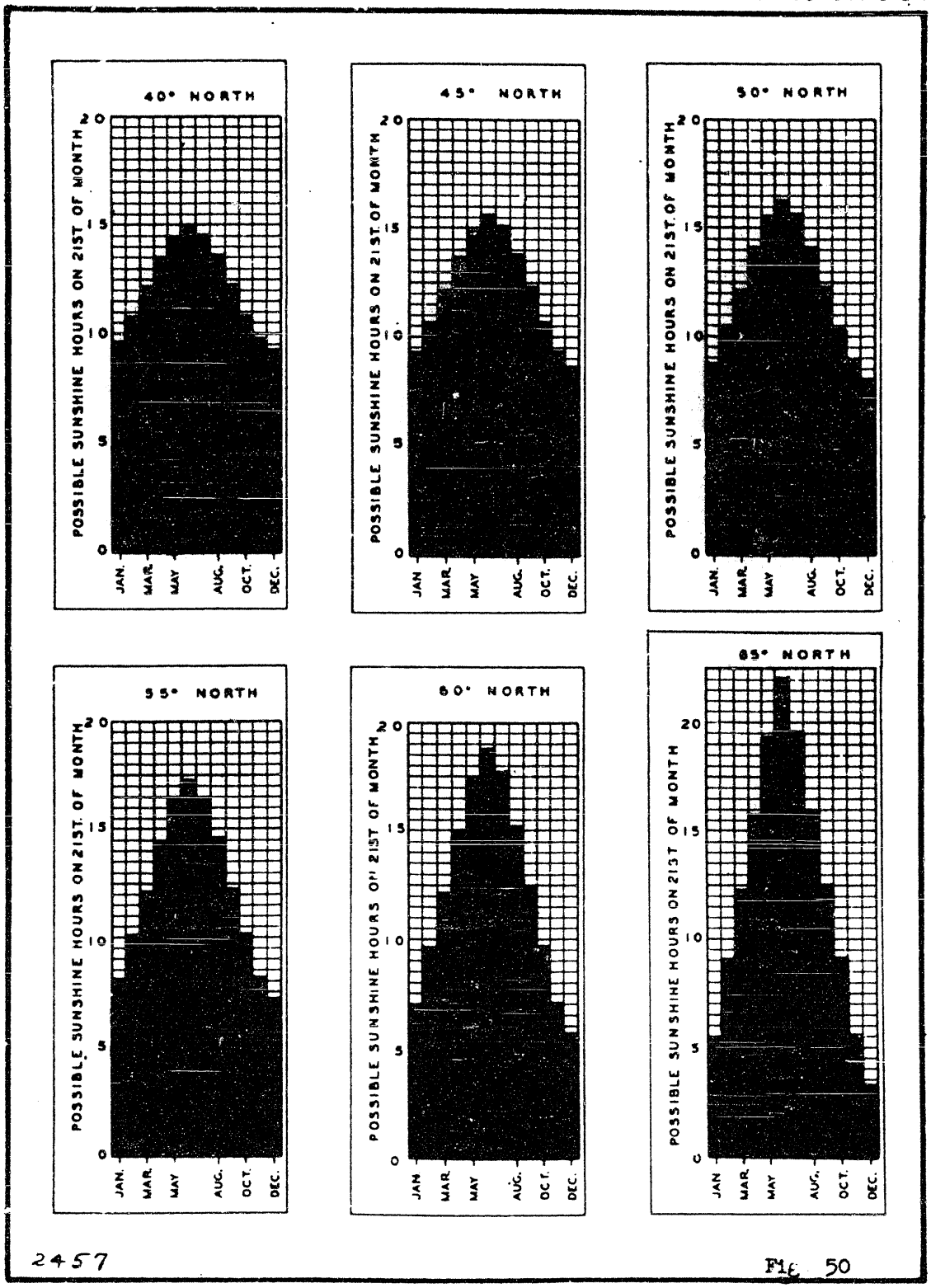

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Fig 50

POSSIBLE SUNSHINE HOURS ON THE 21ST DAY OF EACH MONTH

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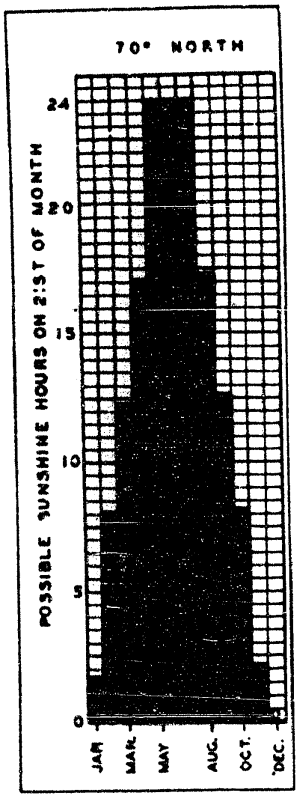

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Fig. 50a

POSSIBLE SUNSHINE HOURS ON THE 21ST DAY OF EACH MONTH

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U. S. DEPARTMENT OF COMMERCE WEATHER BUREAU OFFICE OF STATISTICAL RESEARCH

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TIME OF SUNRISE

LOCAL CIVIL TIME

SEA LEVEL HORIZON

NORTH LATITUDE

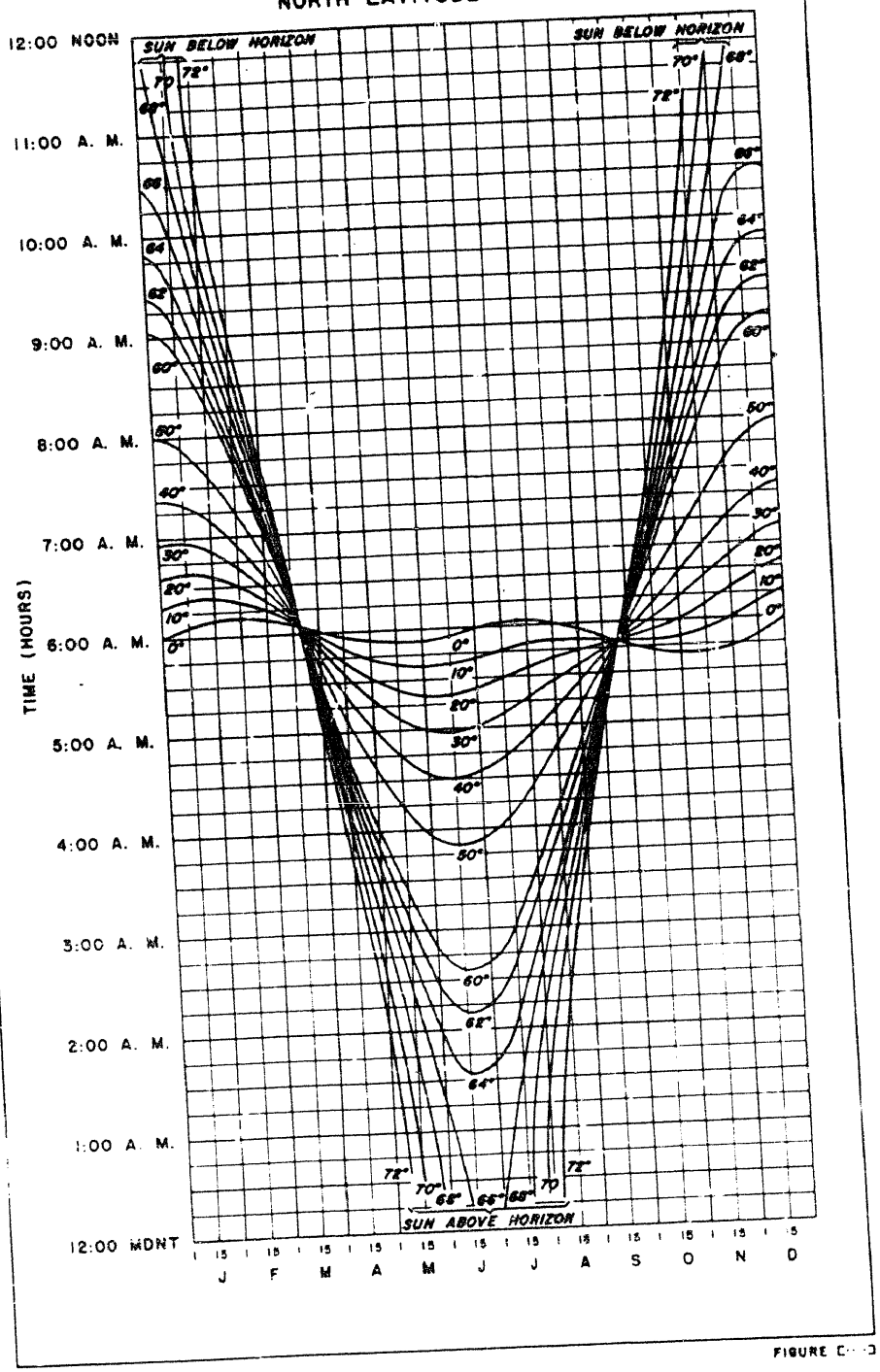

FIGURE C-3

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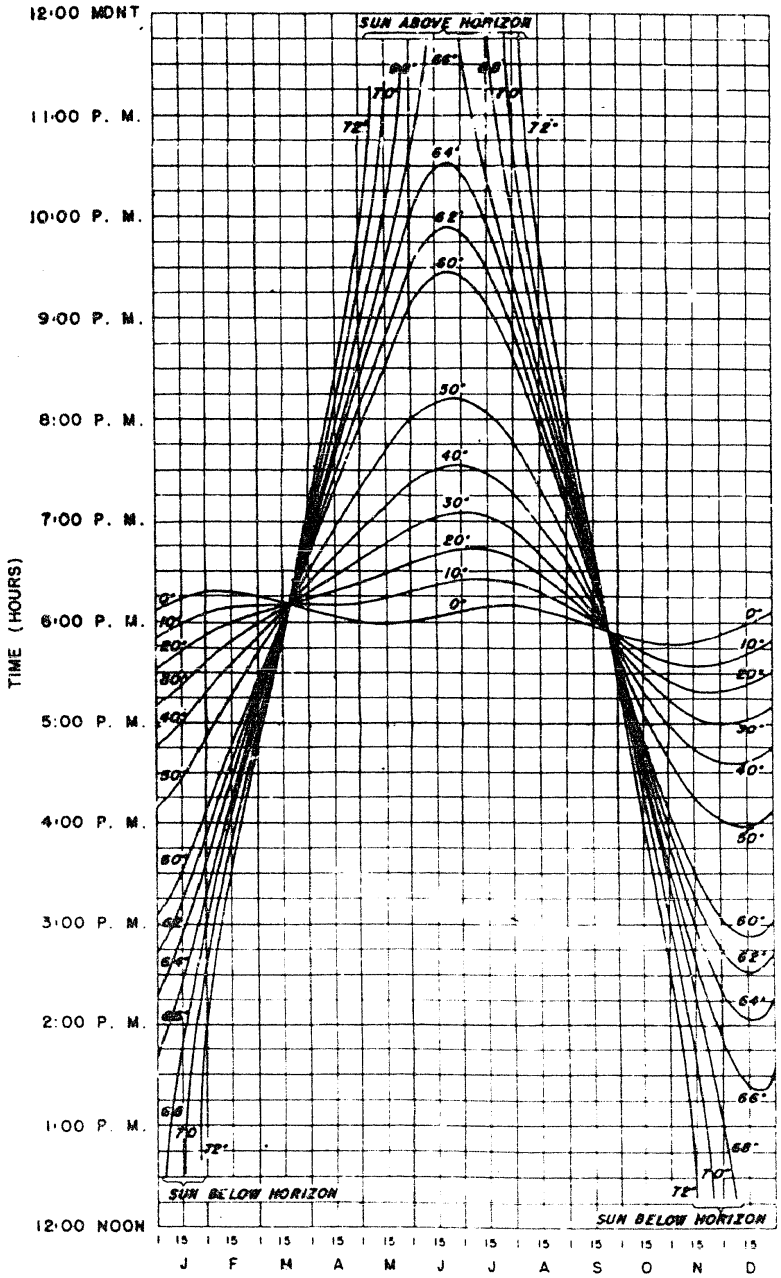
TIME OF SUNSET

LOCAL CIVIL TIME

SEA LEVEL HORIZON

NORTH LATITUDE



04

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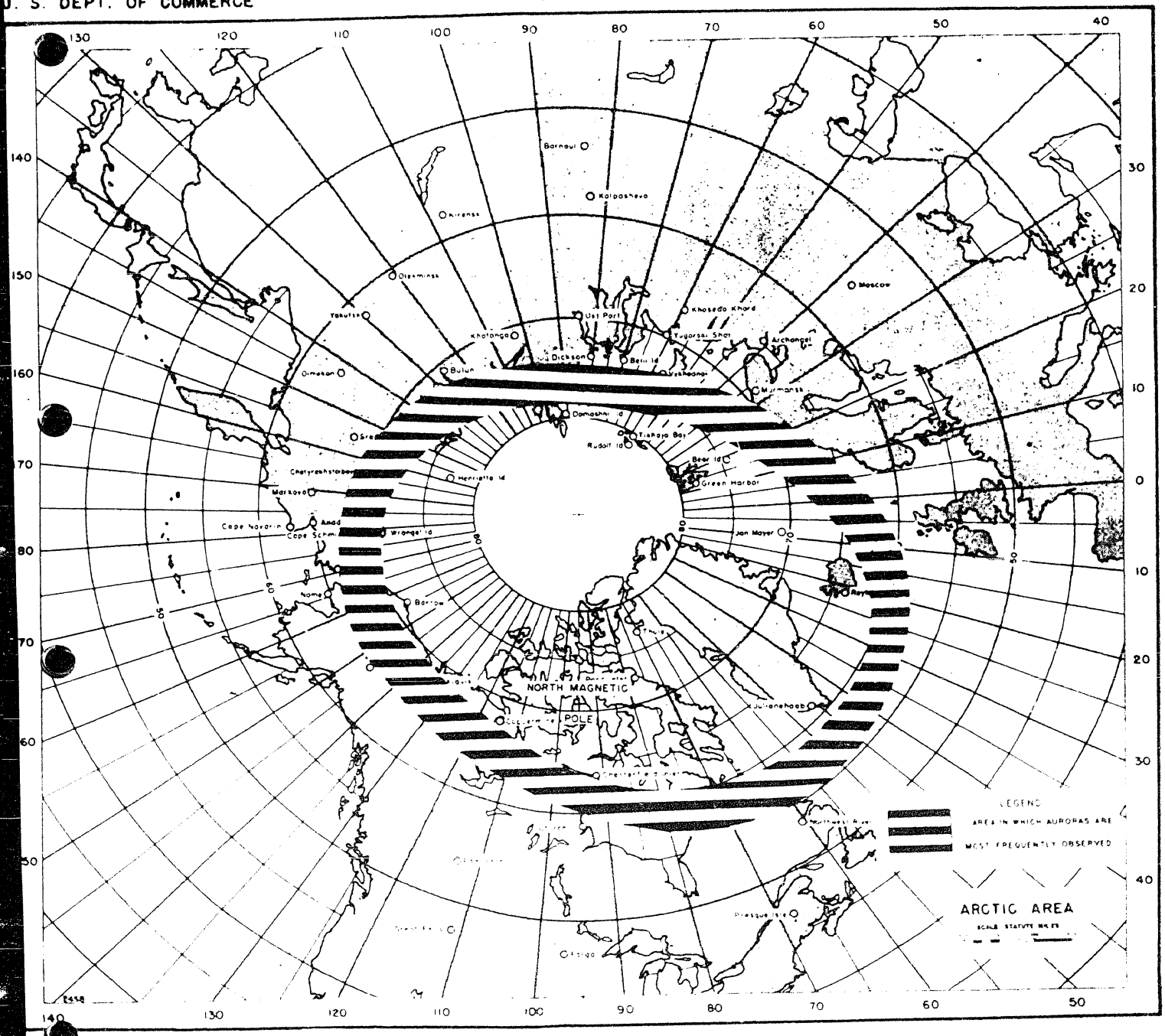

MAXIMUM BELT OF ARCTIC AURORAL FREQUENCY
Fig. 53

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CLOUDINESS

In general, cloudiness over the Arctic regions is greatest in summer and fall and least in winter and spring. This statement should be modified slightly when dealing with specific locations. Those localities in the Arctic Ocean or under the immediate influence of the ocean circulation will have the maximum cloudiness in midsummer. Those localities under the influence of the adjacent continents will have the maximum cloudiness in early autumn, with a secondary maximum in early summer. This may be illustrated from the following data from the "Maud" expedition along and off the northeastern Siberian coast.

Cloudiness In Percent

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
61	54	55	53	81	62	75	74	85	79	64	67
36	42	34	47	73	85	88	88	82	80	51	40

Data on cloudiness for a large number of stations in the Arctic are given in tables 59 and 60. While cloudiness is uniformly high over the areas of maximum cyclonic activity, particularly the Barents Sea and Kara Sea areas, at all seasons of the year, the seasonal variation over other areas is quite marked. Thus, over the zone of inaccessibility--the area of close pack ice at all seasons of the year--the winter and spring cloudiness is probably less than 40%, while the summer and fall cloudiness approaches 90%. In the Barents and Kara Seas, on the other hand, the winter and spring cloudiness will average between 60 and 70% and the summer and fall cloudiness will average over 80%.

In the warmer months of the year cloudiness shows a maximum during the daylight hours and a minimum during the night hours. In some months the trend may be reversed and the maximum cloudiness occur at night. This may be due to the occurrence of fog at night, but further observations are necessary to verify the present data--observations taken over wide areas simultaneously. During the winter half-year the observed diurnal variation is largely due to conditions of the light, more clouds being observed in the daytime or twilight hours than are observed at night.

The character of the cloud deck is quite different over the Arctic Ocean than over more temperate latitudes. Stratus clouds are by far the most frequent type observed; they cover the sky completely and seem to merge with the snow or ice-covered landscape at the skyline. In the summer and fall the stratus clouds will constitute from 70 to 80% of all clouds observed. In the winter and spring they are not quite so frequent, making from 45 to 60% of all cloud types observed. These proportions apply only to conditions over the Arctic Ocean or adjacent seas. Along the coast lines the stratus clouds are slightly less frequent and have a tendency to be more broken up by convective currents, with an increase in the percentage of stratocumulus type of cloud being reported. In the winter, altostratus and cirrostratus clouds are frequently recorded. At this season the clouds are thin; during daylight hours the disk of the sun can frequently be observed through the clouds.

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Cloudless days are uncommon in the Arctic. Days with zero- to two-tenths coverage are most frequent in the winter, averaging from three to ten days, the greater frequency occurring usually in February or March. The greater number of clear days will naturally occur over those areas where anticyclonic conditions are most likely to prevail. Thus the expectancy of clear days is greatest over the interior of the Arctic basin, is large over the lower Mackenzie Valley and the lower Lena and Yana Valleys, and clear days would be least frequent over the Barents and Kara Seas and relatively infrequent over the Chuckchi Sea. Cloudy days, those with eight- to ten-tenths, are most frequent over the Arctic basin in summer. From May to October, the number of cloudy days will average between eighteen and twenty-four over most of the area. There are a few more cloudy days over the pack ice than over the coastal areas. In winter the number of cloudy days will generally average between six and twelve, the greater number of cloudy days occurring in the same areas as the least number of clear days.

The conditions described apply only to the Arctic basin and the adjacent coastal areas. In the interior of the continents within the Arctic zone the cloudiness is appreciably different. In particular the summer cloudiness is much less, with few cloudy or overcast days but with a large proportion of partly cloudy days. The clouds are largely of a cumuliform nature as contrasted to the stratus clouds of the Arctic basin. In winter the cloudiness of these interior sections is largely governed by their location with respect to the moving cyclonic disturbances. Those localities near the paths of the disturbances will have a high percentage of cloudiness with a large number of cloudy days. Other localities far removed from the paths of storms will have less cloudiness and a larger number of clear or partly cloudy days.

Cloud heights are lower in the Arctic than in the temperate latitudes. The most frequent type of cloud, the stratus clouds, will be found anywhere between zero and 5,000 feet. The observations on the "Maud" indicated that the most frequent height would be found below 1,600 feet. However, the measurement of the ceilings were made only when a kite flight or a pilot balloon observation was practicable. With very low clouds in summer, the kites would be iced and forced down so that, in general, measurements of the ceiling would not be attempted with very low clouds. From other sources it is indicated that the height of stratus clouds would frequently be found between 600 and 1,000 feet. Stratocumulus may be expected most frequently around 5,000 feet; as mentioned previously, they are more frequent over the coast than over the sea. Altocumulus will have an average height of 10,000 feet and altostratus about 13,000 feet. The various types of cirrus clouds will be encountered between 15,000 and 30,000 feet.

CEILINGS

The average height of the various types of clouds has been noted in the preceding paragraph. Data on ceilings are difficult to find and are not too reliable. In figures 78 and 79 are shown

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the average occurrence of various ceiling heights for periods varying from one to six years. The data have been collected from synoptic reports and have been reduced to a uniform mean of 30 days for each month. The data may be accepted as showing a general picture of the seasonal and areal differences in the occurrence of ceiling heights, but should not be accepted as definite mean values for the individual stations.

Low ceilings are most frequent over the Kara Sea area. Over the Arctic basin they occur most frequently in the late summer and autumn. Ceilings less than 3,000 feet may be expected on 20 days in the Kara Sea region from August to October and on about 15 days in early summer and late autumn. The best season is late winter and early spring, with approximately 10 days having low ceilings. In the Laptev, east Siberian, and Chukchi Sea areas the number od days with low ceilings will average about 5 less each season than over the Kara Sea area. The conditions over the Berents Sea are similar to those over the Kara Sea. Data for the American portion of the Arctic are not available. Conditions over the northern Alaskan coast and near the mouth of the Mackenzie River should be similar to conditions along the Siberian coast from the mouth of the Lena River eastward. The percentage of observations with low ceilings are shown in table 79 for Barrow, Alaska.

Slightly different conditions are shown by taking the occurrences of very low ceilings (less than 600 feet). The poorest conditions in mid-winter and early spring are to be found in the Kara Sea region, but in late spring the area of most frequent very low ceilings shifts to the extreme northeast of Siberia. Uelen shows the poorest conditions in April, while in May the poor conditions extend from Wrangel Island to Cape Navarin. July and August are the poorest months of the region as a whole, taking into account the occurrence of ceilings less than 600 feet. In July the record at Cape Navarin shows more than 15 days with ceilings less than 600 feet. In the interior, the occurrence of low ceilings is not an important factor. The charts indicate very clearly the desirability of having inland terminals for all flights as contrasted to coastal terminals in the Arctic region. The data show the occurrences of ceilings for three observations daily. Diurnal differences in ceilings are not conclusive from the available data. There is some slight evidence that low ceilings are more frequent in the morning hours during the warmer months of the year but that there is no diurnal variation in winter.

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Table 59

Mean Monthly and Annual Cloudiness (in tenths): Siberian Arctic

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Yrs. Rec.
Anadyr	5.3	6.3	5.4	5.5	6.8	6.8	7.3	7.4	7.3	7.2	6.6	5.9	6.5	16
Archangel	8.1	7.9	8.1	7.0	7.0	6.7	7.1	7.7	8.1	8.3	8.6	8.2	7.7	20
Bear Island	8.2	8.0	8.2	8.6	9.0	8.9	8.7	8.9	9.0	8.6	8.6	8.1	8.6	4
Berufjord	6.4	6.5	6.3	6.7	6.9	6.8	7.1	6.9	6.7	6.6	6.5	6.4	6.7	
Bulun	6.0	4.6	5.6	6.3	6.8	7.5	7.9	7.9	8.1	9.0	7.3	5.9	6.9	12
Cape Cheliuskin	5.6	6.9	4.2	5.1	8.0	9.3	8.1	9.2	9.2	8.9	7.6	6.6	7.4	1
Cape Schmidt	5.7	6.9	6.8	6.0	7.7	8.4	8.0	8.6	9.1	8.3	7.8	7.5	7.6	3
Dickson Island	6.2	6.6	6.0	6.9	8.2	8.7	7.7	8.6	8.8	8.9	7.6	6.1	7.5	
Domashnii Island	5.7	7.1	5.3	5.3	8.1	7.7	8.6	8.9	8.8	8.8	6.1	4.5	7.1	4
Dudinka	6.5	7.0	5.9	6.9	7.5	8.1	7.0	7.5	8.2	8.2	7.2	6.5	7.2	17
Elgiai	6.1	5.1	5.8	6.7	7.9	6.0	5.0	5.3	6.7	7.8	6.9	7.0	6.4	13
Franz Joseph Land	5.6	5.3	5.8	5.5	7.4	8.7	8.3	8.7	7.9	6.8	5.4	4.8	6.7	6
Gjoesvar	6.8	6.5	7.3	7.4	7.9	7.2	6.7	7.1	7.8	7.7	7.7	6.4	7.1	19
Green Harbor	6.2	5.9	5.8	5.6	6.6	7.5	7.0	7.3	7.6	7.2	6.1	5.9	6.6	14
Inari	6.2	5.6	5.6	5.7	6.6	6.6	6.3	6.9	7.2	6.8	6.9	6.6	6.4	30
Jan Mayen	8.4	8.3	7.9	8.3	8.2	8.4	9.0	8.5	8.1	8.3	8.3	8.1	8.3	
Karasjok	6.6	6.3	6.1	6.4	7.0	6.6	6.6	7.1	7.3	7.1	7.0	6.6	6.7	44
Kazachie	4.0	4.8	4.3	5.3	6.6	7.1	7.3	7.9	7.8	7.0	5.5	5.0	6.0	7
Kem	7.6	7.0	6.5	6.8	7.0	6.8	7.1	7.3	7.9	8.3	7.8	8.2	7.4	10
Kola	7.0	7.0	6.0	6.9	7.2	6.8	7.5	7.7	7.7	8.1	7.7	7.6	7.3	19
Grimsey	8.5	8.5	8.3	8.2	8.0	7.8	8.1	7.8	8.3	8.5	8.8	8.6	8.3	
Malyc Karmakuly	8.0	7.7	7.1	7.3	8.2	7.6	7.5	8.1	8.4	8.2	8.3	7.9	7.8	14
Markovo	5.3	5.4	5.0	5.6	6.7	6.5	6.8	7.1	7.1	7.3	6.5	5.6	6.2	21
Moscow	7.1	7.2	7.0	5.2	5.0	5.5	4.8	4.9	6.1	6.8	8.4	8.5	6.4	16
New Siberian Islands	3.0	4.5	3.4	6.2	7.1	8.5	8.4	9.5	9.0	8.1	6.6	4.4	6.6	2 1/2
Nizhne Kolymsk	4.7	4.3	4.0	4.6	5.4	5.3	6.1	7.0	7.3	6.5	6.5	5.1	5.6	6
Novaya Zemlya	4.8	5.2	5.3	6.2	7.7	9.4	8.6	8.6	9.2	8.4	5.2	5.4	6.8	1 1/2
Obdorsk	6.3	6.5	5.9	6.2	7.2	7.5	6.8	7.5	7.9	8.0	7.0	6.7	7.0	33

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Table 59 (cont.)

Mean Monthly and Annual Cloudiness (in tenths): Siberian Arctic (cont.)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Yrs. Rec.
Olekminsk	5.6	6.0	4.9	5.8	6.8	6.5	5.8	6.3	7.0	7.4	6.3	6.8	6.3	23
Reykjavik	7.1	7.2	7.2	7.1	6.9	7.1	7.3	7.3	7.3	6.8	7.0	7.0	7.1	16
Rodchevo	5.3	4.8	4.4	5.2	6.3	6.5	6.1	7.5	7.4	7.1	6.2	5.6	6.0	10
Russkoe Uste	3.4	3.6	3.3	3.6	3.5	7.6	6.8	7.8	8.5	7.3	6.0	4.6	5.8	9
Sagastyr Island	4.0	3.6	3.2	5.3	7.7	8.0	7.6	8.5	9.0	7.2	6.0	5.1	6.3	1-1/2
Sredne Kolymsk	4.0	4.2	3.2	3.4	5.1	5.7	6.2	7.2	7.0	6.8	5.4	4.3	5.3	9
[illegible]ki[illegible]holmur	7.1	7.1	6.7	6.5	6.1	6.4	5.7	5.9	6.7	6.8	7.1	7.0	6.6	
Surgut	6.6	5.9	5.4	5.8	7.0	6.9	6.2	6.8	7.2	8.0	7.2	6.9	6.7	24
Tromso	6.5	6.4	6.0	6.2	6.8	6.8	6.6	6.7	7.6	7.0	7.0	6.0	6.6	44
Trondheim	7.7	7.6	7.3	7.1	7.3	7.3	7.7	7.9	7.9	7.7	7.7	7.5	7.6	44
Turukhansk	6.5	6.4	6.0	6.2	6.8	6.8	6.6	6.7	7.6	7.0	7.0	6.0	6.6	46
Uelen	5.7	6.3	6.1	7.6	8.7	7.3	7.7	8.2	8.5	8.0	8.0	6.8	7.4	8
Vaigach	7.2	6.8	6.4	6.6	8.1	7.9	7.3	7.7	8.3	8.5	8.3	7.5	7.6	
Vardo	7.6	7.4	7.2	7.1	7.6	7.4	7.2	7.5	7.7	7.7	8.0	7.7	7.5	44
Verkhoyansk	3.4	3.1	3.3	4.8	6.1	6.4	6.4	6.6	6.6	6.4	4.6	3.9	5.1	33
Viliuisk	6.6	6.3	5.6	6.5	7.2	7.1	6.7	6.9	7.5	7.9	7.0	6.3	6.8	25
Westmann Island	6.2	6.5	6.1	6.3	5.9	6.3	6.0	5.9	6.6	6.0	6.2	6.0	6.2	
Wrangel Island	5.5	5.8	5.0	5.4	7.9	7.4	7.2	7.9	8.1	7.4	6.7	6.4	6.7	9
Yakutsk	5.2	4.5	3.7	4.9	5.9	5.6	5.6	6.0	6.3	7.3	6.1	5.6	5.6	30
Yugorski St.	7.0	6.6	6.3	7.0	8.4	7.9	7.5	8.1	8.6	8.5	8.3	7.4	7.6	20
"Fram"	3.6	4.1	5.6	4.8	7.6	8.7	9.1	8.5	9.1	6.3	3.9	3.6	6.2	2-1/2
"Maud"	3.6	4.2	3.4	4.7	7.3	8.5	8.8	8.8	8.2	8.0	5.1	4.0	6.2	2

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Table 60

Mean Monthly and Annual Cloudiness (in tenths): North American Arctic

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Yrs. Rec.
Aklavik	4.1	4.2	4.3	4.4	4.5	5.1	6.0	7.4	7.0	6.7	5.3	4.5	5.4	8
Angmagssalik	6.7	6.1	6.1	6.1	6.3	6.2	5.6	5.4	6.3	6.8	6.7	6.6	6.2	-
Barrow*	4.2	2.4	3.1	4.5	7.1	6.1	6.2	8.2	8.2	7.4	4.7	4.8	5.6	5
Bethel*	4.7	4.4	4.0	5.4	5.8	5.0	6.8	7.0	6.2	5.4	4.7	4.8	5.4	-
Cambridge Bay*	3.0	2.6	2.9	3.6	7.4	5.8	4.8	8.2	7.9	6.7	4.3	-	-	1
Churchill	4.5	5.2	3.8	5.3	5.6	5.2	5.0	4.8	5.9	6.8	5.3	5.0	5.2	5
Coppermine*	4.6	4.6	4.5	5.3	6.2	5.8	5.8	7.4	7.8	6.8	5.6	4.7	5.8	6
Craig Harbour*	3.9	4.2	5.0	5.4	6.0	7.2	6.2	7.6	7.8	7.0	5.8	3.4	5.8	3
Cumberland Sound	5.0	5.5	6.4	6.2	7.0	8.2	8.0	7.8	8.4	7.1	7.4	5.8	6.9	-
Danmarkshavn	6.3	4.4	5.0	3.2	4.3	5.2	5.1	4.8	4.8	4.6	5.9	5.4	4.9	5
Dawson	5.7	4.9	4.4	4.8	4.9	5.3	5.8	5.8	5.9	6.3	6.2	6.3	5.5	15
Dutch Harbor*	7.6	7.6	7.4	7.9	8.0	8.0	7.7	7.5	8.0	7.9	7.5	7.2	7.7	16
Eagle	4.9	5.0	5.4	5.6	6.1	5.6	6.2	6.8	7.2	6.6	5.7	4.8	5.8	10
Edmonton	4.6	4.8	5.1	5.7	6.2	6.1	5.5	5.4	5.5	5.2	5.4	5.0	5.4	17
Ellesmere Island (South Coast)	2.0	4.1	3.4	4.5	6.2	6.6	6.2	7.8	6.1	5.7	3.3	3.3	5.1	2-4
Fairbanks*	5.2	5.3	4.9	5.0	6.9	6.3	6.6	7.5	7.2	6.5	6.1	5.0	6.1	10
Fort Chipewyan	5.3	5.1	5.2	5.5	5.9	5.9	4.9	5.2	6.7	6.1	6.9	6.4	5.8	7
Fort Conger	3.4	2.8	5.0	3.5	6.0	6.6	7.0	7.8	6.3	4.4	2.8	3.6	4.9	2
Fort Good Hope	4.4	4.4	3.8	4.4	4.6	4.2	4.3	5.1	6.3	6.4	5.3	4.1	4.8	-
Fort Norman*	3.7	3.4	3.8	4.6	4.8	4.9	5.6	6.2	6.2	7.0	4.3	4.0	5.0	4
Godhavn	6.9	6.8	6.3	6.2	6.7	6.0	6.3	6.0	6.0	6.1	7.1	6.9	6.4	-
Godthaab	7.3	6.9	6.8	6.9	6.8	6.8	6.6	6.9	6.8	6.7	6.6	6.8	6.9	-
Hay River	5.2	4.7	4.9	4.5	5.4	5.0	4.5	4.4	6.6	6.7	6.2	4.7	5.2	18
Hebron	4.9	5.1	5.5	6.7	7.6	7.4	7.0	6.6	6.4	6.8	7.2	6.1	6.4	6
Ivigtut	5.8	5.4	5.5	5.6	6.0	6.1	5.8	6.2	6.2	5.8	5.6	5.9	5.8	-
Jakobshavn	4.4	3.9	4.2	4.5	4.8	4.9	4.8	4.8	5.0	5.1	5.1	4.8	4.6	-

* Mean of a.m. and p.m. observations.

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Table 60 (cont.)

Mean Monthly and Annual Cloudiness (in tenths): North American Arctic (cont.)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Yrs. Rec.
Jones Sound	1.9	3.7	3.1	4.7	5.6	6.1	6.3	7.8	6.5	6.5	3.2	2.8	4.9	-
Julianehaab	5.8	5.8	5.8	6.0	6.1	6.8	6.6	6.7	6.4	6.1	5.9	5.7	6.2	-
Kane Basin	2.7	3.2	2.8	4.1	4.7	4.0	5.0	8.0	6.0	6.8	5.2	2.9	4.6	-
Lake Harbour*	4.8	5.0	4.8	5.7	6.7	6.8	6.4	5.1	5.4	7.0	6.5	5.1	5.9	2
Mygg-Bukta	4.2	4.8	5.0	4.1	5.0	6.4	6.0	6.5	5.6	4.9	5.0	4.9	5.2	-
Nain	5.0	4.1	4.7	6.2	7.2	7.1	6.8	6.5	6.4	6.0	5.7	5.1	6.1	6
Nanortalik	6.7	6.5	6.6	6.4	6.6	6.8	6.5	6.6	6.7	6.3	6.3	6.3	6.5	-
Nome*	5.4	5.2	5.0	6.4	6.2	6.2	7.9	7.5	6.8	7.8	5.8	5.8	6.2	10
Pangnirtung*	3.6	4.4	2.6	5.0	6.4	5.6	6.2	6.5	6.3	8.0	6.6	4.8	5.3	2
Pond Inlet*	3.6	3.6	4.0	3.0	4.8	5.8	4.8	6.0	7.0	7.8	5.2	3.0	4.9	5
Port Nelson	5.2	4.6	4.2	6.4	6.8	6.8	6.4	6.3	7.2	7.8	7.6	5.4	6.2	-
Resolution Island*	6.8	6.3	6.8	7.4	8.0	7.4	7.0	6.7	7.4	7.9	8.5	7.6	7.3	6
Scoresbysund	5.9	7.1	5.0	6.8	5.3	5.8	5.1	5.5	5.1	5.4	5.3	6.2	5.7	-
Simpson Strait	3.2	2.5	2.7	4.2	6.8	6.9	5.8	6.8	8.5	6.8	5.6	2.7	5.2	-
St. Paul Island*	7.8	7.6	7.4	7.9	8.8	9.0	9.4	9.4	8.4	8.4	8.1	7.5	8.3	1
Upernavik	4.4	4.3	4.5	5.1	6.6	6.9	6.3	6.9	7.1	7.1	7.1	5.5	6.0	-
Winnipeg	4.6	4.7	4.9	4.8	4.2	4.8	4.2	4.1	5.1	5.6	6.0	5.3	4.9	-

* Mean of a.m. and p.m. observations.

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TABLE 61

Mean Monthly and Annual Number of Clear, Partly Cloudy, and Cloudy Days: Siberia

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Yrs. Rec
Archangel														18
Clear	1	2	3	3	1	3	1	1	1	1	1	1	19	
Pt. Cloudy	10	10	14	13	16	15	16	14	11	10	8	10	147	
Cloudy	20	16	14	14	14	12	14	16	18	20	21	20	199	
Pernaul														11
Clear	1	3	6	6	4	2	4	4	4	3	2	2	41	
Pt. Cloudy	15	16	15	16	17	20	20	20	16	13	11	13	192	
Cloudy	15	9	10	8	10	8	7	7	10	15	17	16	132	
Bear Island														
Clear	1	1	1	1	*	1	*	*	*	0	0	1	6	
Pt. Cloudy	13	11	12	9	7	7	8	8	5	11	12	13	116	
Cloudy	17	16	18	20	24	22	23	23	25	20	18	17	243	
Bulun														20
Clear	11	12	12	10	8	5	5	6	4	3	7	11	94	
Pt. Cloudy	4	4	5	5	5	5	5	4	4	2	4	4	51	
Cloudy	16	12	14	15	18	20	21	21	22	26	19	16	220	
Cape Cheliuskin														1
Clear	6	4	9	5	1	0	2	0	0	0	4	4	35	
Pt. Cloudy	18	13	19	19	12	5	10	5	4	9	9	14	137	
Cloudy	7	11	3	6	18	25	19	26	26	22	17	12	193	
Cape Schmidt														3
Clear	8	6	7	6	2	2	2	1	1	1	2	3	41	
Pt. Cloudy	15	12	11	10	11	9	10	8	6	10	12	14	128	
Cloudy	8	10	13	14	18	19	19	22	23	20	16	14	196	

* Less than 0.5 day.

** Clear days = 0; partly cloudy days = 1-9; cloudy days = 10.

Note: Clear days = 0-2;
Partly cloudy days = 3-7;
Cloudy days = 8-10.

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Table 61 (cont.)

Mean Monthly and Annual Number of Clear, Partly Cloudy, and Cloudy Days: Siberia (cont.)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Yrs. Rec.
Dickson Island														
Clear	9	8	9	6	4	3	5	3	1	3	6	9	66	
Pt. Cloudy	3	4	6	5	3	3	4	4	3	3	3	5	46	
Cloudy	19	16	16	19	24	24	22	24	26	25	22	17	253	3-4
Domashnii Island														
Clear	7	2	8	6	1	2	2	0	1	1	6	10	46	
Pt. Cloudy	14	13	14	14	12	10	6	10	7	11	14	15	140	
Cloudy	10	13	9	10	18	18	23	21	22	19	10	6	179	3
Dudinka														
Clear	11	4	13	6	5	2	4	6	1	3	6	11	72	
Pt. Cloudy	13	7	9	10	9	12	12	10	8	9	11	13	123	
Cloudy	7	11	9	14	17	16	15	15	21	19	13	7	170	12
Gjesvar**														
Clear	3	3	3	3	3	3	4	4	1	2	2	4	35	
Pt. Cloudy	13	10	11	10	10	10	11	12	12	13	12	14	138	
Cloudy	15	15	17	17	18	17	16	15	17	16	16	13	192	
Green Harbor														
Clear	6	6	7	7	4	3	3	2	2	3	6	7	56	
Pt. Cloudy	12	10	13	13	14	10	12	12	12	12	12	13	145	
Cloudy	13	12	11	10	13	17	16	17	16	16	12	11	164	7
Lyakhovski Island														
Clear	8	8	12	10	5	3	4	2	2	5	7	6	72	
Pt. Cloudy	3	3	3	4	3	2	3	2	2	2	3	3	33	
Cloudy	20	17	16	16	23	25	24	27	26	24	20	22	260	7
Kazachie														
Clear	17	13	16	12	8	5	5	4	4	7	11	13	115	
Pt. Cloudy	4	3	4	4	4	6	6	4	5	5	5	5	55	
Cloudy	10	12	11	14	19	19	20	23	21	19	14	13	195	

** Clear days = 0; partly cloudy days = 1-9; cloudy days = 10.

Note: Clear days = 0-2; partly cloudy days = 3-7; cloudy days = 8-10.

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Table 61 (cont.)

Mean Monthly and Annual Number of Clear, Partly Cloudy, and Cloudy Days: Siberia (cont.)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Yrs. Rec.
Kem														10
Clear	2	4	4	3	2	2	1	1	1	1	2	1	24	
Pt. Cloudy	12	10	15	14	16	16	16	17	12	10	10	10	158	
Cloudy	17	14	12	13	13	12	14	13	17	20	18	20	183	
Kirensk														10
Clear	6	5	5	4	3	4	4	4	2	3	3	7	50	
Pt. Cloudy	13	15	15	16	16	16	18	15	14	11	10	11	170	
Cloudy	12	8	11	10	12	10	9	12	14	17	17	13	145	
Kola														1
Clear	2	2	4	2	2	2	*	*	1	1	1	1	18	
Pt. Cloudy	16	15	18	16	15	16	16	16	14	12	14	14	182	
Cloudy	13	11	9	12	14	12	15	15	15	18	15	16	165	
Jan Mayen														
Clear	1	*	1	*	*	*	*	*	*	*	*	*	2	
Pt. Cloudy	10	8	12	10	13	9	7	9	11	11	11	13	124	
Cloudy	20	20	18	20	18	21	24	22	19	20	19	18	239	
Markovo														10
Clear	9	8	9	7	4	3	2	3	3	4	5	6	53	
Pt. Cloudy	12	10	13	14	13	17	17	15	13	12	13	13	162	
Cloudy	10	10	9	9	14	10	12	13	15	15	12	12	141	
Moscow														10
Clear	3	3	3	6	6	4	4	6	2	3	1	1	42	
Pt. Cloudy	10	10	11	14	18	20	21	17	15	11	7	7	161	
Cloudy	18	15	17	10	7	6	6	8	13	17	22	23	162	
Nizhne Kolymsk														5
Clear	10	9	11	9	7	5	5	2	3	3	3	8	75	
Pt. Cloudy	14	14	17	14	16	19	16	16	12	15	17	15	185	
Cloudy	7	5	3	7	8	6	10	13	15	13	10	8	105	

* Less than 0.5 day.

Note: Clear days = 0-2; Partly cloudy days = 3-7; Cloudy days = 8-10.

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Table 61 (cont.)

Mean Monthly and Annual Number of Clear, Partly Cloudy, and Cloudy Days: Siberia (cont.)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Yrs. Rec.
Obdorsk														10
Clear	4	3	4	3	2	2	3	2	1	1	2	4	31	
Pt. Cloudy	12	12	16	13	10	11	14	15	13	12	12	12	152	
Cloudy	15	13	11	14	19	17	14	14	16	18	16	15	182	
Olekminsk														8
Clear	5	1	4	4	1	2	5	3	2	1	3	4	35	
Pt. Cloudy	13	17	19	17	15	17	17	16	13	14	12	15	185	
Cloudy	13	10	8	9	15	11	9	12	15	16	15	12	145	
Rodchevo														4
Clear	6	7	7	5	1	5	3	*	2	2	3	3	44	
Pt. Cloudy	18	13	19	18	15	14	18	12	12	17	17	15	188	
Cloudy	7	8	5	7	15	11	10	19	16	12	10	13	133	
Russkoe Uste														5
Clear	17	14	15	13	4	2	4	2	1	3	7	11	93	
Pt. Cloudy	9	9	13	12	13	12	12	8	5	10	9	11	123	
Cloudy	5	5	3	5	14	16	15	21	24	18	14	9	149	
Sagastyr														2-3
Clear	15	15	17	11	5	4	5	2	2	6	7	13	102	
Pt. Cloudy	4	3	5	3	3	4	2	4	3	4	4	6	45	
Cloudy	12	10	9	16	23	22	24	25	25	21	19	12	218	
Sredne Kolymsk														9
Clear	14	11	13	15	8	5	5	2	3	4	8	10	98	
Pt. Cloudy	11	11	14	10	14	16	15	13	12	14	12	15	157	
Cloudy	6	6	4	5	9	9	11	16	15	13	10	6	110	
Stykkisholmur														
Clear	1	2	3	2	3	2	3	3	2	2	1	2	26	
Pt. Cloudy	18	13	18	19	20	19	19	20	17	18	17	17	215	
Cloudy	12	13	10	9	8	9	9	8	11	11	12	12	124	

* Less than 0.5 day.

Note: Clear days = 0-2; partly cloudy days = 3-7; cloudy days = 8-10.

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Table 61 (cont.)

Mean Monthly and Annual Number of Clear, Partly Cloudy, and Cloudy Days: Siberia (cont.)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Yrs. Rec.
Surgut												"		10
Clear	5	3	5	6	3	2	3	3	1	2	3	3	39	
Pt. Cloudy	12	16	17	16	17	18	15	15	4	13	12	13	188	
Cloudy	14	9	9	8	11	10	9	9	15	16	15	15	138	
Tiksi Bay														2-3
Clear	6	7	12	10	6	4	7	5	2	4	5	13	81	
Pt. Cloudy	2	3	3	4	3	3	3	2	4	4	6	4	41	
Cloudy	23	18	16	16	22	23	21	24	24	23	19	14	243	
Turukhansk														11
Clear	6	6	7	7	4	3	3	3	2	2	5	6	54	
Pt. Cloudy	13	11	14	13	13	15	18	14	12	9	10	12	154	
Cloudy	12	11	10	10	14	12	10	14	16	20	15	13	157	
Uelen														8
Clear	6	6	5	2	1	1	2	1	1	2	2	5	34	
Pt. Cloudy	15	11	16	12	10	16	11	11	8	10	8	14	142	
Cloudy	10	11	10	16	20	13	18	19	21	19	20	12	189	
Verdo**														25
Clear	2	2	3	2	2	2	2	2	1	1	1	2	22	
Pt. Cloudy	13	13	14	13	11	12	13	12	14	13	12	12	152	
Cloudy	16	13	14	15	18	16	16	17	15	17	17	17	191	
Vaigach														
Clear	6	7	9	8	4	5	6	5	2	2	3	6	63	
Pt. Cloudy	4	4	5	5	3	3	4	4	5	5	4	3	49	
Cloudy	21	17	17	17	24	22	21	22	23	24	24	21	253	
Verkhoyansk														8
Clear	12	11	12	9	4	2	3	2	3	5	9	9	81	
Pt. Cloudy	15	13	15	13	16	15	17	15	14	14	14	16	177	
Cloudy	4	4	4	8	11	13	11	14	13	12	7	6	107	

** Clear days = 0; Partly cloudy days = 1-9; Cloudy days = 10.

Note: Clear days = 0-2; Partly cloudy days = 3-7; Cloudy days = 8-10.

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Table 61 (cont.)

Mean Monthly and Annual Number of Clear, Partly Cloudy, and Cloudy Days: Siberia (cont.)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Yrs. Rec.
Wrangel Island														5
Clear	6	4	6	5	2	2	1	0	1	1	[illegible]	4	34	
Pt. Cloudy	18	18	18	16	11	13	16	14	14	15	17	17	187	
Cloudy	7	6	7	9	18	15	14	17	15	15	11	10	144	
Yakutsk														24
Clear	10	9	14	9	5	5	5	5	5	3	6	7	83	
Pt. Cloudy	14	13	14	15	18	19	19	17	16	16	16	15	192	
Cloudy	7	6	3	6	8	6	7	9	9	12	8	[illegible]	90	
Yugorski Strait														
Clear	7	8	9	7	3	4	5	4	2	[illegible]	3	[illegible]	61	
Pt. Cloudy	5	4	5	5	3	3	5	4	4	4	3	3	46	
Cloudy	19	16	17	18	25	23	21	23	24	24	[illegible]	22	256	
"Fram"														2 1/2
Clear	14	12	9	8	7	0	0	0	0	4	11	15	80	
Pt. Cloudy	9	10	8	13	6	4	4	7	3	15	13	10	102	
Cloudy	8	6	14	9	18	26	27	24	27	12	[illegible]	[illegible]	183	
"Maud"														2
Clear	14	9	12	10	2	0	0	0	1	1	7	9	65	
Pt. Cloudy	13	13	16	12	13	14	9	5	9	13	15	18	164	
Cloudy	4	6	3	8	16	16	22	26	20	7	4	4	136	

Note: Clear days = 0-2; Partly cloudy days = 3-7; Cloudy days = 8-10.

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Table 62

Mean Monthly and Annual Number of Clear, Partly Cloudy and Cloudy Days:
North America and Greenland

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Yrs. Rec.
Anchorage*														10
Clear	9	8	10	9	4	6	5	3	5	6	8	10	83	
Pt. Cloudy	8	6	9	9	13	13	10	12	12	11	7	9	119	
Cloudy	14	14	12	12	14	11	16	16	13	14	15	12	163	
Angmagssalik														
Clear	4	4	6	7	8	6	6	9	7	5	3	6	71	
Pt. Cloudy	15	13	13	13	12	15	15	13	14	14	15	15	167	
Cloudy	12	11	12	10	11	9	10	9	9	12	12	10	137	
Barrow*														10
Clear	17	18	18	14	7	9	8	4	4	6	12	13	130	
Pt. Cloudy	4	4	5	5	5	7	7	6	5	6	5	5	64	
Cloudy	10	6	8	11	19	14	16	21	21	19	13	13	171	
Bethel*														10
Clear	11	11	14	10	6	10	5	5	7	9	13	11	117	
Pt. Cloudy	5	5	6	8	9	9	6	8	7	7	5	6	81	
Cloudy	15	12	11	12	16	11	20	18	16	15	12	14	172	
Dawson														
Clear	5	5	8	10	6	2	4	2	6	3	3	4	58	
Pt. Cloudy	13	16	18	15	19	23	19	18	13	13	12	15	194	
Cloudy	13	7	5	5	6	5	8	11	11	15	15	12	113	
Dutch Harbor*														10
Clear	3	2	3	2	2	2	3	4	2	2	3	2	30	
Pt. Cloudy	8	7	8	7	8	7	9	8	9	8	8	11	98	
Cloudy	20	19	20	21	21	21	19	19	19	21	19	18	237	

* In Alaska, clear days = 0-3; partly cloudy days = 4-7; cloudy days = 8-10.
Note: Clear days = 0-2; partly cloudy days = 3-7; cloudy days = 8-10, except stations in Alaska marked with an asterisk.

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Table 62 (cont.)

Mean Monthly and Annual Number of Clear, Partly Cloudy and Cloudy Days:
North America and Greenland (cont.)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Yrs. Rec.
Eagle*														10
Clear	12	10	10	10	6	8	7	6	5	7	8	12	101	
Pt. Cloudy	4	4	6	5	7	6	6	5	5	4	5	5	62	
Cloudy	15	14	15	15	18	16	18	20	20	[illegible]	17	14	202	
Edmonton														
Clear	6	7	6	5	4	4	3	5	6	6	7	7	66	
Pt. Cloudy	15	14	18	18	20	18	21	21	20	20	18	18	221	
Cloudy	10	7	7	7	7	8	7	5	4	5	[illegible]	6	78	
Ellesmere Island														3
(South Coast)														
Clear	20	11	13	9	6	5	6	1	1	7	15	14	108	
Pt. Cloudy	9	11	15	15	11	11	11	11	11	13	12	13	143	
Cloudy	2	6	3	6	14	14	14	19	18	11	3	4	114	
Fairbanks*														10
Clear	10	9	11	10	4	4	5	3	4	5	6	11	84	
Pt. Cloudy	6	6	7	9	11	14	9	6	7	[illegible]	6	6	93	
Cloudy	15	13	13	11	16	12	17	22	19	20	16	14	188	

* In Alaska, clear days = 0-3; partly cloudy days = 4-7; cloudy days = 8-10.
Note: Except at stations in Alaska, clear days = 0-2; partly cloudy days = 3-7, cloudy days = 8-10.

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Table 62 (cont.)

Mean Monthly and Annual Number of Clear, Partly Cloudy and Cloudy Days:
North America and Greenland (cont.)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Yrs. Rec.
Fort Chipewyan														
Clear	9	12	13	11	10	8	12	12	8	5	10	8	118	
Pt. Cloudy	9	11	10	11	14	13	13	13	10	14	10	11	139	
Cloudy	13	5	8	8	7	9	6	6	12	12	10	12	108	2
Fort Conger														
Clear	16	14	8	12	5	4	4	1	4	12	17	16	113	
Pt. Cloudy	11	12	17	15	14	11	19	14	15	12	10	11	151	
Cloudy	4	2	6	3	12	15	18	16	11	7	3	4	101	
Godhavn														
Clear	3	3	5	5	5	6	5	6	6	5	3	3	55	
Pt. Cloudy	15	13	13	14	14	13	13	13	13	14	13	14	163	
Cloudy	13	12	13	11	12	11	13	12	11	12	14	13	147	
Godthaab														
Clear	1	1	2	2	3	2	2	2	2	3	2	2	24	
Pt. Cloudy	15	15	16	16	15	16	17	15	15	14	15	17	186	
Cloudy	15	12	13	12	13	12	12	14	13	14	13	12	155	
Hay River														
Clear	9	9	10	10	8	8	9	8	4	4	6	10	95	
Pt. Cloudy	11	9	10	11	11	12	14	13	13	11	10	13	138	
Cloudy	11	10	11	9	12	10	8	10	13	16	14	8	132	
Ivigtut														
Clear	5	7	7	9	9	7	8	7	7	7	7	7	87	
Pt. Cloudy	13	9	12	10	12	12	11	11	12	11	11	14	138	
Cloudy	13	12	12	11	10	11	12	13	11	13	12	10	140	
Jakobshavn														
Clear	4	7	7	6	6	5	7	6	6	5	5	6	70	
Pt. Cloudy	22	18	20	20	20	21	20	20	20	22	21	19	243	
Cloudy	5	3	4	4	5	4	4	5	4	4	4	6	52	

Note: Except at stations in Alaska, clear days = 0-2; partly cloudy days = 3-7; cloudy days = 8-10.

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Table 62 (cont.)

Mean Monthly and Annual Number of Clear, Partly Cloudy and Cloudy Days
North America and Greenland (cont.)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Yrs. Rec.
King William Island														2
Clear	14	16	16	8	4	4	6	2	0	3	5	10	87	
Pt. Cloudy	12	12	14	14	13	10	17	16	10	16	13	20	167	
Cloudy	5	0	1	8	14	16	8	13	20	13	12	1	111	
Mygg-Bukta														
Clear	12	10	9	11	8	5	6	4	4	9	4	11	93	
Pt. Cloudy	11	10	14	14	14	13	13	17	20	14	20	13	170	
Cloudy	8	8	8	5	9	12	12	10	6	8	6	10	102	
Nain														
Clear	10	13	12	8	4	6	5	6	5	7	8	10	94	
Pt. Cloudy	12	10	10	10	13	10	14	13	14	12	12	15	143	
Cloudy	9	5	9	12	14	14	12	12	11	12	11	6	128	
Nunortalik														
Clear	2	2	4	3	4	2	3	2	3	4	4	2	35	
Pt. Cloudy	16	15	15	16	17	17	17	16	16	15	14	18	192	
Cloudy	13	11	12	11	10	11	11	13	11	12	12	11	138	
Nome*														19
Clear	10	11	12	9	9	8	5	4	6	7	10	11	102	
Pt. Cloudy	7	6	6	7	10	9	7	8	8	8	6	5	87	
Cloudy	14	11	13	14	12	13	19	19	16	16	14	15	176	

* In Alaska, clear days = 0-3; partly cloudy days = 4-7; cloudy days = 8-10.
Note: Except at stations in Alaska, clear days = 0-2; partly cloudy days = 3-7; cloudy days = 8-10.

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Table 62 (cont.)

Mean Monthly and Annual Number of Clear, Partly Cloudy and Cloudy Days
North America and Greenland (cont.)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Yrs. Rec.
Fort Nelson														
Clear	7	9	10	6	3	3	3	4	3	1	4	6	59	
Pt. Cloudy	8	9	10	7	8	9	8	11	8	5	5	8	96	
Cloudy	16	10	11	17	20	18	20	16	19	25	21	17	210	
Scoresbysund														
Clear	7	2	8	7	7	6	7	5	7	7	8	7	78	
Pt. Cloudy	12	12	14	13	13	14	15	19	15	14	12	11	164	
Cloudy	12	14	9	10	11	10	9	7	8	10	10	13	123	19
St. Paul Island*														
Clear	3	2	4	3	2	2	1	1	1	1	2	2	24	
Pt. Cloudy	7	8	8	7	6	4	4	5	7	7	6	8	77	
Cloudy	21	18	19	20	23	24	26	25	22	23	22	21	264	
Upernavik														
Clear	8	10	10	8	5	4	5	4	3	3	3	6	69	
Pt. Cloudy	15	13	15	14	13	12	12	13	13	17	13	14	164	
Cloudy	8	5	6	8	13	14	14	14	14	11	14	11	132	
Winnipeg														
Clear	8	7	7	7	6	6	6	7	5	7	5	7	78	
Pt. Clougy	16	13	15	16	18	18	19	19	17	16	18	15	203	
Cloudy	7	8	5	7	7	6	6	5	8	8	8	9	84	

* In Alaska, clear days = 0-3; partly cloudy days = 4-7; cloudy days = 8-10.
Note: In North America and Greenland, clear days = 0-2; partly cloudy days = 3-7; cloudy days = 8-10.

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TEMPERATURE

The most common misconception of the Arctic is that the land areas are covered with eternal ice and snow; that there is everlasting winter with intense cold; and with the everlastingness of winter an absence of summer and lack of vegetation. Greenland is a striking example of a glacier-covered land possessing these qualities and from it the rest of the north has been pictured by analogy. The high elevation of Greenland and the rather heavy precipitation it receives are two factors which highly favor glaciation. In general, however, the Arctic lands possess neither of these characteristics. Over a large portion of the Arctic the scanty snows melt rapidly with the approach of summer. Otherwise, glaciers would soon form. Most of what little snow does fall is soon swept by the wind into gullies and into the lee of the hills, so that more than three-fourths of the Arctic lands are comparatively free of snow at all seasons.

Next, considering the intense cold, it has been shown that the North Pole, which lies in a deep ocean, temperatures below -60° F. are not possible. At Herschell Island, off the north coast of Canada, the absolute minimum over a long period has been 54° below zero. Several hundred miles south, at Fort Good Hope, we find the lowest official temperature ever recorded in North America, 79° below zero. Even at Havre, Montana, we find the temperature -68°, or 8° colder than is theoretically possible at the Pole. The coldest observed temperature on the surface of the earth was recorded at Verkhoyansk, near the Arctic Circle in eastern Siberia, well over 1,500 miles from the geographic Pole. Until a few years ago this station has enjoyed the doubtful honor of experiencing colder winter weather than any other known place in the world. In 1929 a station was opened in the Oimekon River district, some 400 miles southeast of Verkhoyansk, and from the brief record available it is noted that the winter temperatures have consistently averaged lower than those for the same time at Verkhoyansk. The lowest reading at the new station is -85°, only 5° from the record of -90° found at Verkhoyansk. It is not at all improbable that a lower record will be established at this new station.

On the other hand, there is always a summer in the Arctic, with vegetation, the presence of birds, and the buzz of millions of insects. The myriads of mosquitoes can and do cause more distress than the cold. Not infrequently complaints of the summer heat are voiced. A maximum of 100° in the shade has been recorded above the Arctic Circle and maximum readings from 80° to 90° at stations not on the coast are the rule rather than the exception. Even with the lower maxima farther north, the high relative humidity produces oppressive conditions. Then, too, the heavy clothing necessary for protection against the insects adds to the general discomfort. Whereas native clothing is much more satisfactory in winter, the clothing of the white man is better than that of the Eskimo for summer use.

A huge variety of climatic conditions are encountered in these regions. Areas adjacent to one another are found to have widely different climatic characteristics, determined by latitude, marine influence, and topography. A study of annual temperature curves reveals three well defined types, namely, maritime, coastal, and continental.

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(1) In the Polar Sea the temperature in June, July, and August deviates very slightly from the freezing point, thus producing a flat curve in summer. Likewise in winter there is a flatness to the curve, but this time the temperature stays around -30°.

(2) The coastal climate closely resembles the maritime, with the year consisting primarily of a long cold winter and a short cool summer similar to fall or spring as experienced on the continent. The annual curve has the same winter characteristics as that of the Polar Sea but there is a seasonal maximum in July during summer. The mean summer temperature, however, remains under 50°.

(3) The Arctic continental climate is characterized by very low winter temperatures with a pronounced winter minimum, and high summer temperatures with a highly pronounced summer maximum. Here the annual ranges of mean temperature may be as much as 80 or 100°. The changes from winter to summer and vice versa are necessarily rapid, with rather long transition periods.

The winter and summer temperatures are of especial interest and will be discussed more fully.

The prominent feature of the winter temperature at Arctic stations in the vicinity of the coast is that the temperatures remain nearly constant for a considerable length of time. The coldest month of the year, on the average, is not January but February. For many stations it is March, and in some years even April has a lower mean than January. Bear Island is one case in particular which shows this tendency. The high pressure cell in the Polar Sea has become well developed by late winter and as the mean position of the Arctic Front shifts southward we find conditions favorable to produce these low temperatures as late as March and April.

As is clear from the isothermal chart for February (figure 55), the influence of the land and sea on the temperature distribution in winter is particularly strong and produces large zonal differences. In summer the isotherms run nearly parallel with the lines of latitude. (See August temperature chart, figure 56.) It is evident, therefore, from the steeper gradients, that temperature differences are much greater in winter than in summer. The steepest gradient is found in northwestern British Columbia where the temperature drops from 50° to zero in less than 100 miles. The barrier effect of the mountains close to the coast which keeps out the Arctic cold, and the warm waters of the Pacific with onshore winds, must explain the situation.

On the European Continent there is no mountain barrier near the coast and the warm Atlantic drift has a marked influence on the temperature of central and northwestern Europe. The prevailing westerly winds carry the oceanic influence far inland. In the south, on the other hand, the prevailing northeast winds originate in the heart of the continent and subsequently are quite cold. These facts account for the marked northwest to southeast trend of the winter isotherms in Russia and western and central Siberia. The temperature decreases with

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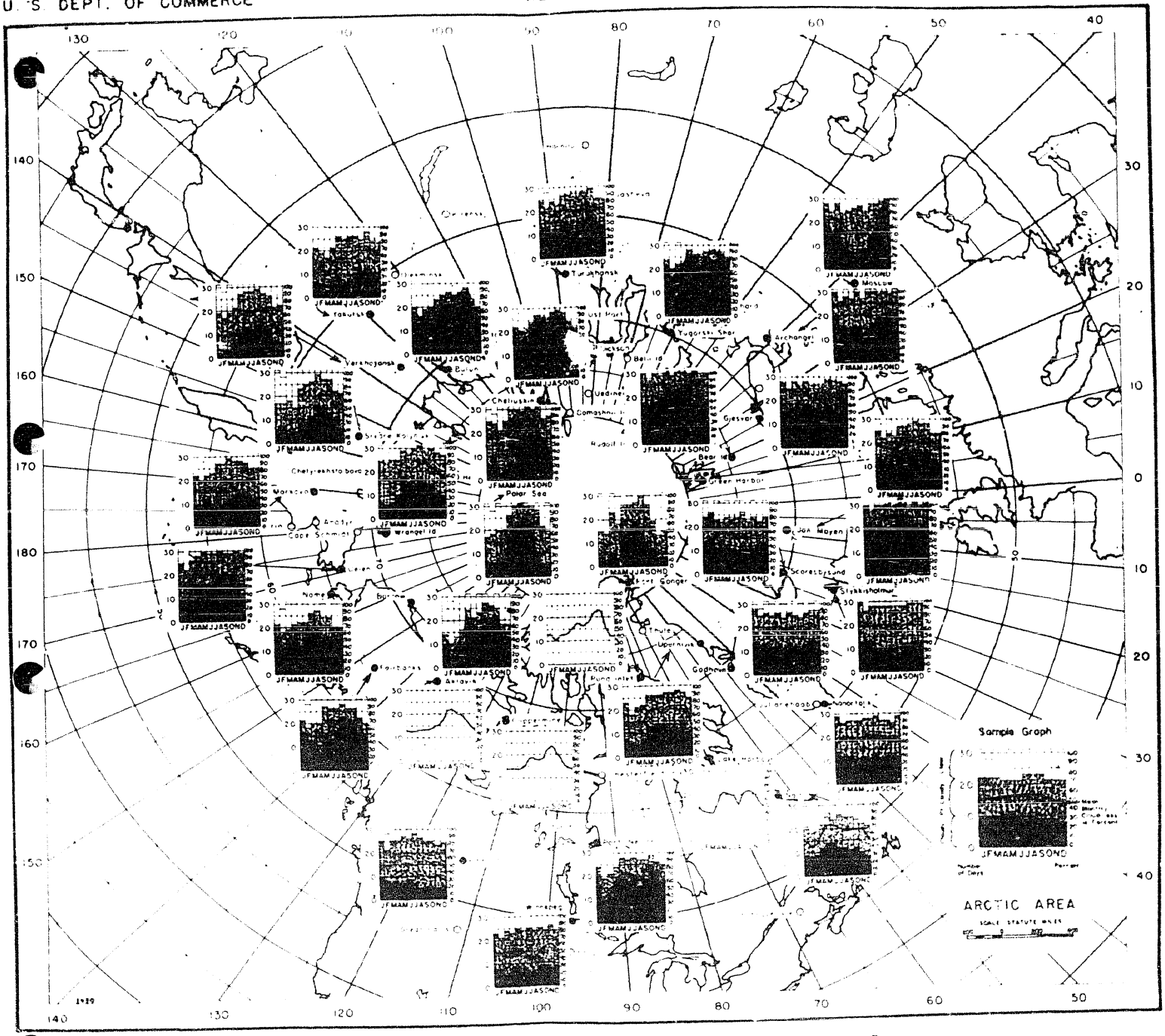

NUMBER OF CLEAR, PARTLY CLOUDY AND CLOUDY DAYS AND MEAN MONTHLY CLOUDINESS IN PERCENT

Fig. 54

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marked uniformity as we advance toward northeastern Siberia till we arrive at the region around Verkhoyansk, known as the "cold pole" of the world. Here the January average is 58° below zero and never in this month has the temperature risen higher than 2° above zero. The absolute minimum of -90° is the lowest reading ever taken on the surface of the earth. With a July average of 60° the annual range of 118° is the greatest for any station. Also, the absolute range is the largest ever recorded, from 90° below zero to 94° above, no less than 184°.

That this area should have the most extreme winters known to man is readily understood from its geographical location. The heat of the North Atlantic can not penetrate the 3,000 miles of frozen continent, the Pacific Ocean has no appreciable effect since ranges of hills intervene and winds are prevailingly offshore, the ice-covered Arctic Ocean certainly cannot ameliorate the harsh conditions, and the lofty ranges of central Asia check any influence from the warm Indian Ocean far to the south. The characteristic "lag" of seasons, so highly pronounced on the Arctic coast and conspicuous at any locality with maritime influence, is, as would be expected, almost totally absent. The temperature curve follows more nearly that of insolation, and April is as warm as October. In the interior of Canada the same characteristics are evident but since the area is not comparable to the vastness of the Siberian Continent, the feature is less pronounced. In the following table a comparison of April and October average temperatures is made for selected Siberian stations.

Station	April	October
Yakutsk (interior)	16.7	16.7
Verkhoyansk (interior)	9.3	5.7
Bulun (near the coast)	4.6	11.3
Russkoe Uste (on the coast)	-7.8	9.0

The extremely cold temperatures found at these inland stations are partially explained by the fact that the stations are low in elevation and are located as a rule at the bottom of a valley. It is well known that steep inversions prevail and the low temperatures may be considered more or less local in character. Much warmer temperatures are found at increased elevations, as is evidenced from the following comparison of Semenovsky Rudnik, elevation 3,346 feet and Yakutsk, 354 feet. The two stations are about 150 miles apart. (See figure 55.)

1917	Oct	Nov	Dec	Jan	Feb	Mar	1918
Semonovsky Rudnik	12.1	-11.6	-13.5	-20.6	-18.8	-12.5	
Yakutsk	21.9	-13.9	-42.5	-41.6	-33.0	-9.6	
Difference	-9.8	2.3	29.0	21.0	14.2	-2.9	

The Siberian winter is by no means as unpleasant as its extreme temperatures might suggest. The air is often calm and the skies clear. Danger to man

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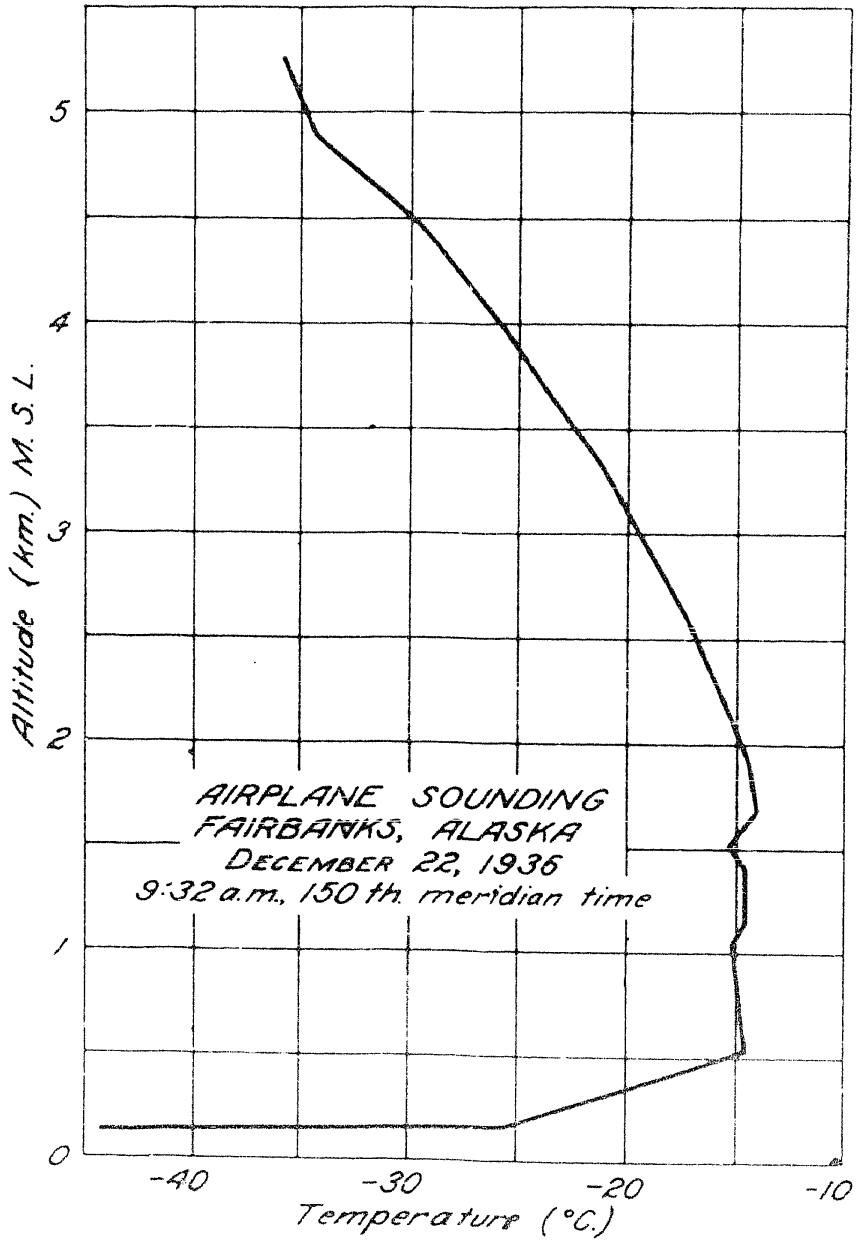

Fig. 55

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or beast occurs only when the "wild buran" or "purga" blows. These fearful blizzards also occur in interior Canada.

While the coldest temperatures are found in lower latitudes, these areas do not have the long periods of cold which are found in the more northerly regions along the coast. In the Canadian Archipelago, from December 4, 1923 to February 27, 1924 the temperature at Pond Inlet did not rise above zero, while on 28 days of that period it fell to -40° or lower. These cold spells may occur earlier or later in the winter. Again at Pond Inlet, from February 28 to March 26, 1923, the temperature fell to 40° below zero or lower on every day but one when it reached -39°. Not till the end of April do we find days with temperature rising above the freezing point in this region, and minima of zero can be found in all but the three summer months.

As has already been noted, average temperatures near the Polar Sea are higher than in the interior. That the maritime effect of the ice-covered sea could produce the large differences observed is not logical and the explanaton lies in the physical characteristics of the land. With no hills or trees of any consequence to act as frictional resistance to the wind, more freedom of movement is allowed. This produces a greater degree of mixing in the surface layers which transports warmer air to the surface.

Irregularities of the winter isotherms in the Polar Sea are produced by the influence of the Atlantic and Pacific Oceans. In the North Atlantic the isotherms are pushed far northward and here we find the greatest positive anomaly of temperature in the world (i.e., the greatest departure from the laditudinal average). The winter temperatures in the vicinity of Bering Strait are influenced by the open waters of the Bering Sea. North of the Strait the influence is limited to a rather small area with large local differences occurring with different wind directions. Northerly and especially northeasterly winds bring temperatures characteristic of the ice-covered sea, while scutheasterly winds transport air with a much higher temperature.

The temperature inversions which we have noted in all Arctic regions are especially prominent over the pack ice in the Polar Sea. The diurnal variation during the dark season is, as would be expected, rather irregular. From the available data it is discovered that the maximum occurs at night hours and the minimum in the middle of the day. Again it is the wind which accounts for the irregularity. Any slight increase in wind, regardless of direction, will produce a considerable rise in temperature by the process of mixing. Since the diurnal variation of wind is largely dependent on the diurnal variation of pressure it is possible to set up definite relations which exist among temperature, wind, and pressure.

Small temperature variability in summer is a characteristic common to all stations in the inner polar areas. The temperatures in the pack ice never deviate far from the freezing point. The diurnal ranges are smaller and the interdiurnal changes are less in summer than in any other season. Warm air from the inland is often transported a

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considerable distance from the coast, but in passing over the icy waters it is cooled so effectively by contact with the ice that a sharp inversion is formed. Thus, the warm air current flows at some distance from the ground and has practically no influence on the surface temperature. Considerably higher temperatures are found on the coast and the transition from coastal to maritime conditions takes place over a very short distance. The isotherm for 32° has been added to the August temperature chart, figure 57, to emphasize this surface discontinuity. However, this characteristic holds for the surface layers only and is not found at higher levels. The discontinuity, therefore, represents only a quasifront and is of no consequence to the circulation of the atmosphere.

The warmest month in the Arctic over both land and sea areas is, with but few exceptions, July. However, the August temperature chart is representative of summer conditions. It is highly probable that everywhere in the Polar Sea the average temperature for July is within a few tenths of a degree from the freezing point, whereas in June and August the average is slightly below 30°.

The highest temperature observed on the "Fram" expedition in the Polar Sea was 39.2° in June 1896, and observers on the "Maud" found an absolute maximum of 38.3 in June 1923. That both values occurred in June is probably explained by the fact that maximum cloudiness in this area occurs in July and August. At coastal stations much higher readings are found and maxima near 70° are quite common. Still greater maxima are recorded at inland stations and temperatures above 90° are the rule at stations near the Arctic Circle which are a considerable distance from the sea.

There are two features worthy of note which characterize the summer temperatures in the Polar Sea: first, the temperature is near freezing everywhere with no variation with latitude, and secondly, again independent of latitude, the first day with a maximum temperature and the first day with a mean temperature of 32° or higher is nearly the same in all sections except those under the influence of warm winds from the south.

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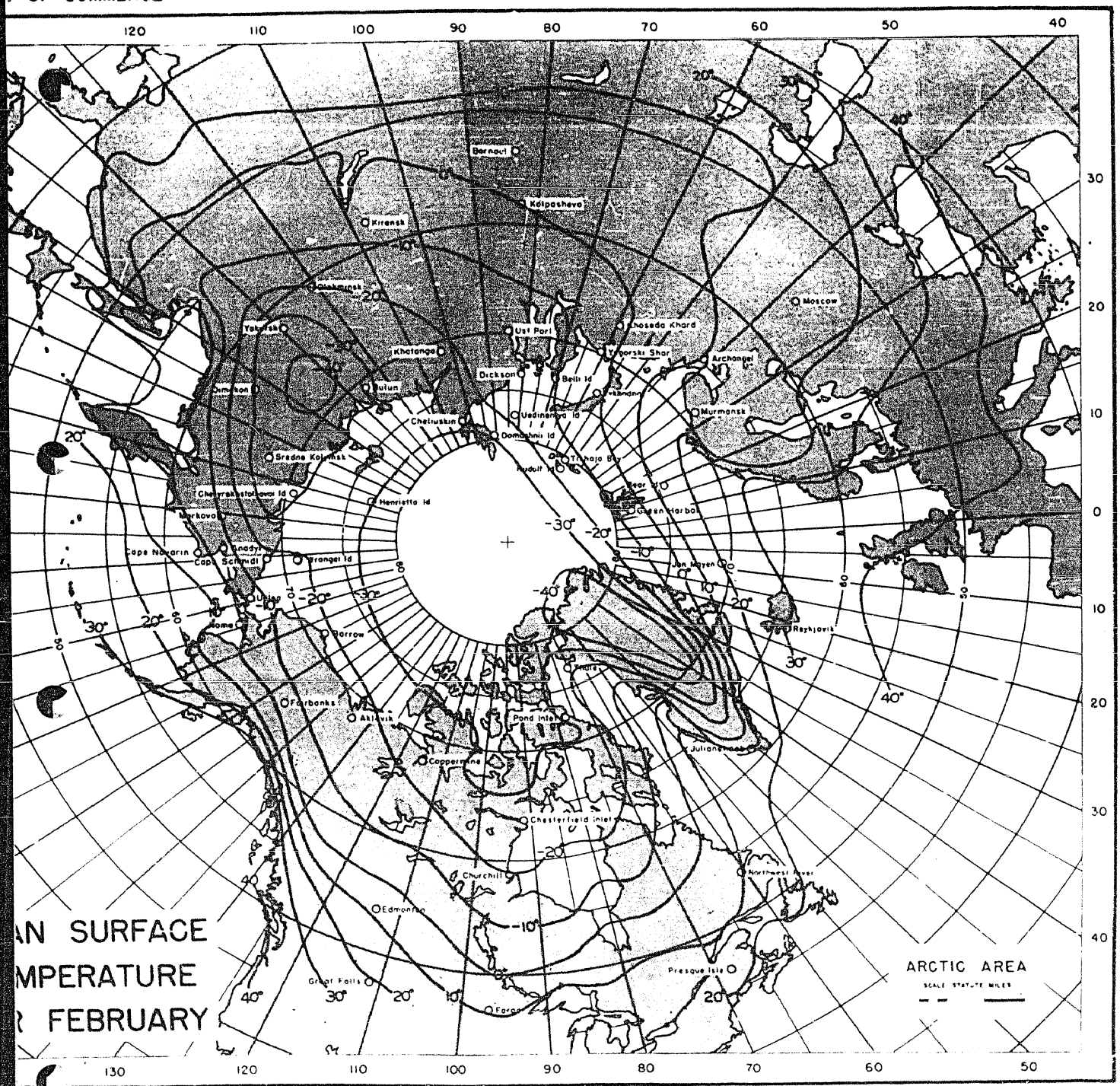

AN SURFACE
MPERATURE
R FEBRUARY

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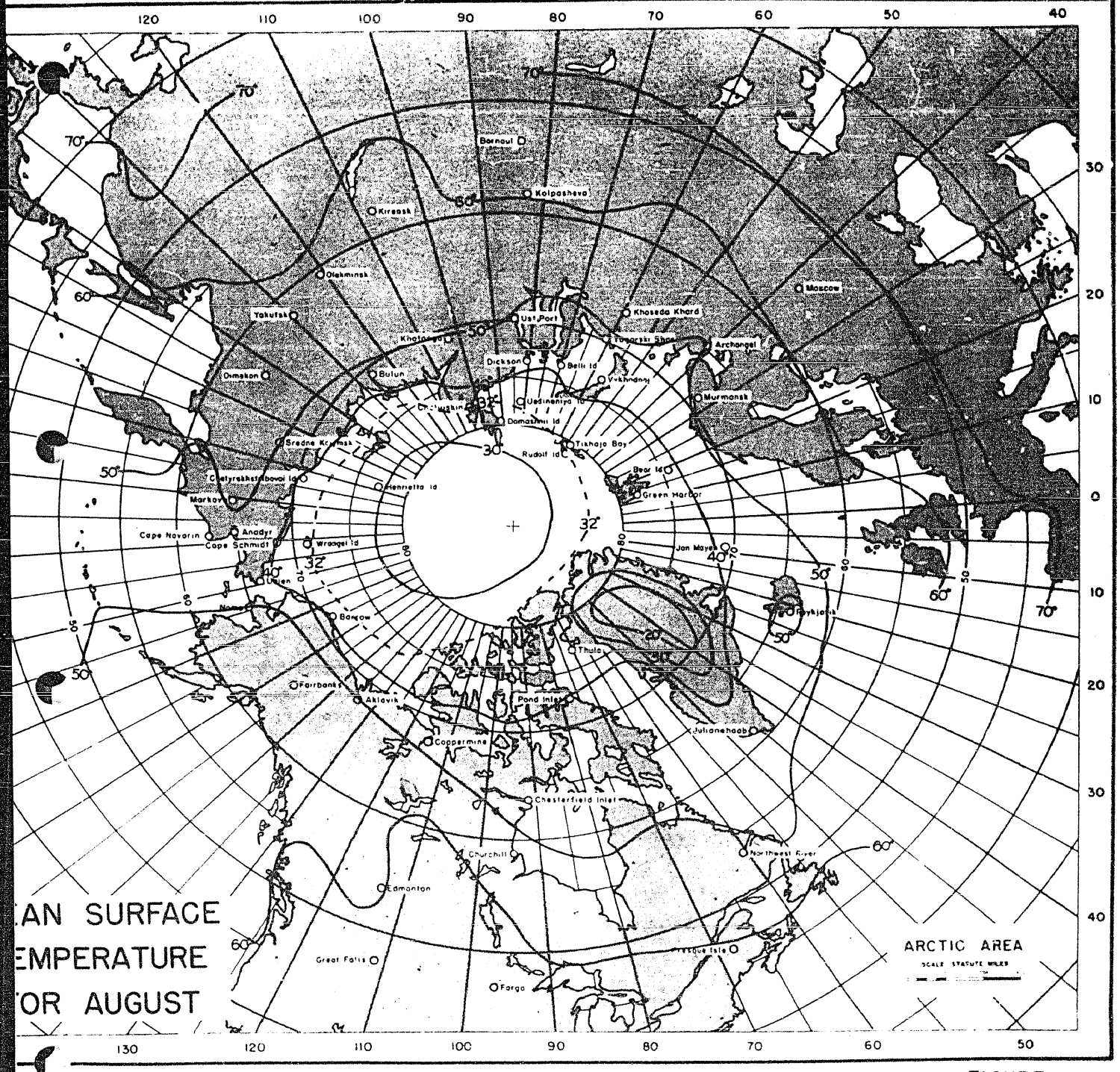

AN SURFACE
EMPERATURE
OR AUGUST

2408

BASE STAT 422066-2

FIGURE

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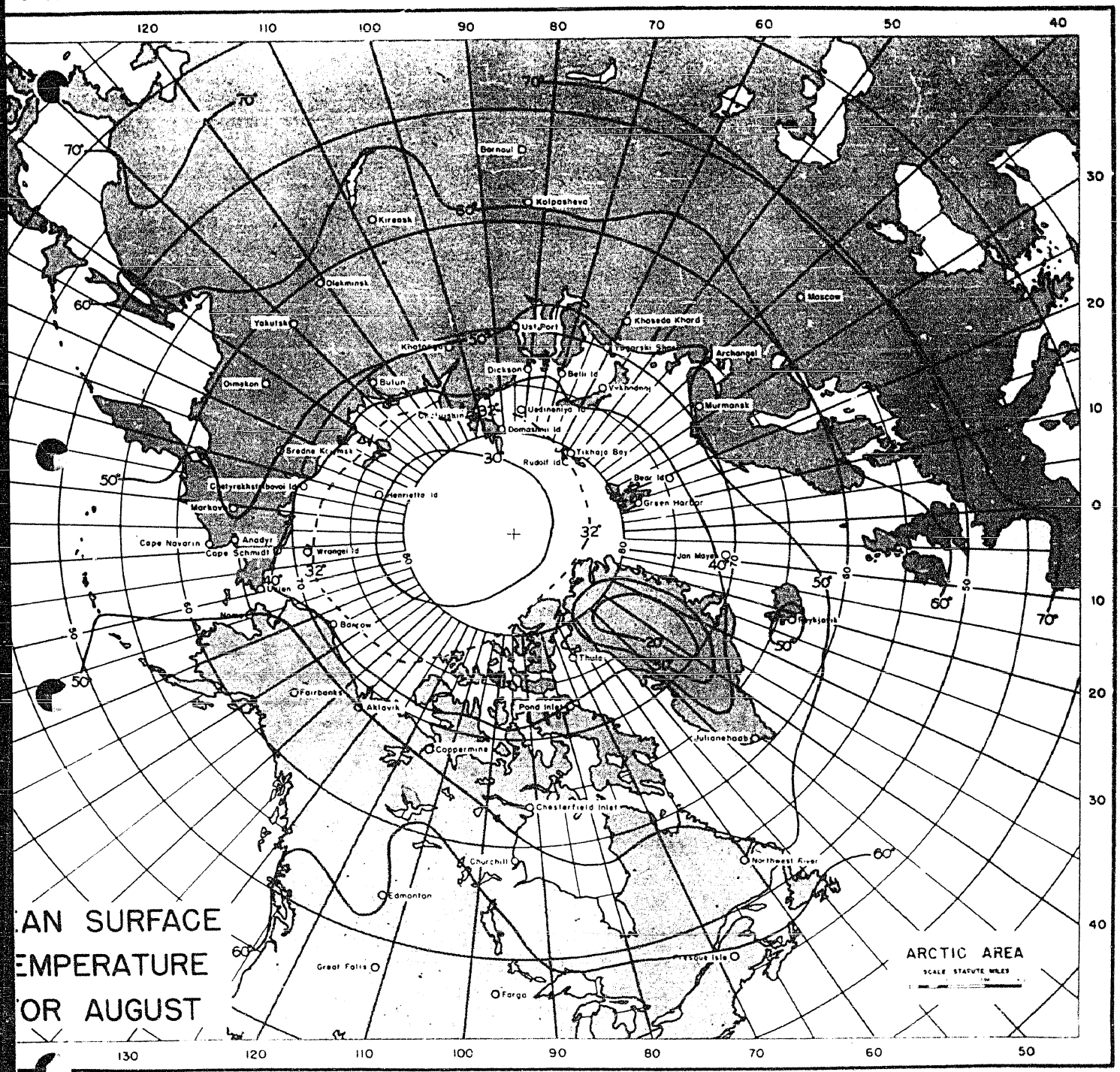

AN SURFACE
EMPERATURE
OR AUGUST

2408

BASE STAT 422086-2

FIGURE

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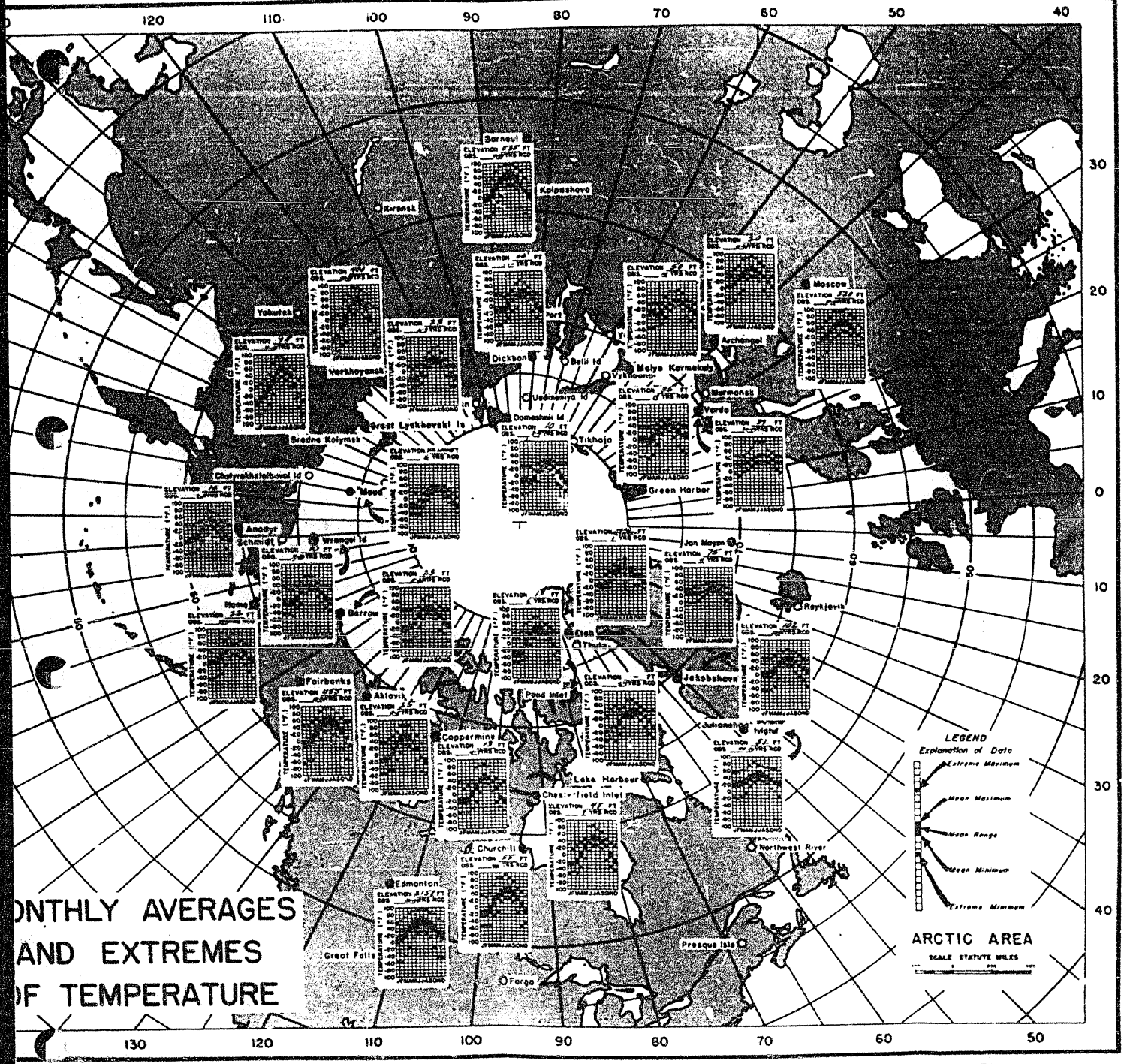

ONTHLY AVERAGES
AND EXTREMES
OF TEMPERATURE

122410 BASE STAT 422086-2 FIGURE

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Table 63

Mean Monthly and Annual Temperatures (°F.) with Absolute Extremes:
North American Arctic

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Abs. Max.	Abs. Min.	Yrs. Rec.
Aklavik	-21.4	-15.5	-7.0	8.4	30.6	48.4	55.5	49.8	37.6	17.4	-5.9	-17.4	15.0	85	-56	8
Anchorage	11.3	18.0	22.3	34.9	44.8	52.8	57.0	55.4	47.8	35.1	22.5	12.7	34.6	84	-36	23
Angmagssalik	17.6	15.6	18.9	24.8	33.8	40.8	44.8	42.6	37.6	29.8	23.0	19.9	29.1	77	-26	36
Atlin	2.0	8.4	18.4	31.4	42.8	50.6	54.0	52.3	45.0	35.6	22.8	13.2	31.4	86	-58	22
Banks St.	-31.2	-31.5	-24.0	-2.9	16.0	34.3	38.7	34.9	22.8	0.9	-12.3	-22.2	1.9			3
Barrow	-16.2	-17.0	-14.8	-0.4	19.6	34.7	40.0	38.6	31.6	16.6	-0.3	-11.0	10.2	78	-56	28
Barrow St.	-31.5	-29.6	-21.1	-3.6	15.6	33.8	37.9	35.1	21.9	6.8	-8.3	-25.6	2.7			5
Calgary	13.2	17.1	26.2	40.1	49.5	56.3	61.5	59.7	50.9	41.7	27.3	19.2	38.7			50
Chesterfield Inlet	-26.6	-26.0	-17.3	1.2	20.8	37.2	48.0	46.3	37.8	23.6	0.4	-16.9	10.7	84	-55	9
Churchill	-18.9	17.3	-6.2	14.8	29.1	42.5	52.9	52.0	41.0	26.4	6.8	-10.5	17.7	96	-57	45
Coppermine	-21.2	-21.1	-16.0	-0.9	20.8	39.2	40.0	46.0	35.1	15.9	-10.2	-20.3	8.9	87	-54	5
Craig Harbour	-22.1	-21.5	-14.4	-5.4	15.4	32.7	40.5	38.1	28.6	11.7	-2.9	-17.0	7.0	60	-49	3
Cumberland Sound	-20.2	-24.7	-9.4	7.9	26.4	35.8	42.4	42.4	35.8	20.7	3.4	-9.6	12.7			
Danmarkshavn	-7.4	-17.3	-8.3	-3.1	18.9	34.0	39.9	36.0	24.8	6.1	-4.7	-5.6	9.3	63	-42	2
Dawson	-22.4	-11.8	4.4	27.6	46.3	56.8	59.3	54.3	41.6	26.2	1.2	-11.2	22.7	95	-68	30
Dutch Harbor	32.1	31.6	34.1	35.9	40.7	46.0	51.3	52.9	48.5	42.1	36.4	33.1	40.4	80	5	20
Edmonton	5.5	10.5	23.4	40.5	51.0	57.2	61.1	59.2	50.2	41.1	24.7	14.3	36.5	98	-57	40

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Table 63 (cont.)

Mean Monthly and Annual Temperature (°F.) with Absolute Extremes:
North American Arctic (cont.)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Abs. Max.	Abs. Min.	Yrs. Rec.
Etah	-14.2	-12.9	-7.4	0.8	22.6	38.8	---	---	25.2	11.4	4.5	-7.7	---	60	-30	1
Fairbanks	11.2	-1.6	9.5	29.2	46.9	58.3	60.1	54.8	43.6	26.7	4.1	-7.1	26.1	99	-66	36
Fargo	4.5	8.8	23.9	42.1	54.5	64.6	69.4	67.1	57.8	44.8	26.7	12.5	39.7	114	-48	48
Fond du Lac	-19.2	-15.0	-2.1	19.2	38.2	52.0	59.4	56.7	44.9	32.6	19.2	-7.2	22.4	90	-61	24
Fort Chipewyan	-12.7	-6.9	4.9	26.6	42.3	52.9	59.4	55.8	44.4	32.5	14.4	-1.8	26.0	93	-60	45
Fort Congor	-37.0	-42.7	-23.9	-11.7	16.1	32.7	37.0	34.3	14.5	-8.5	-26.2	-29.9	-3.8	53	-62	3
Fort George	-11.9	-9.3	1.1	21.5	36.7	47.7	54.4	52.6	46.4	35.4	22.6	4.5	25.1	94	-52	13
Fort Good Hope	-22.9	-18.2	-9.7	13.6	37.8	54.0	59.5	52.9	39.1	21.0	-6.5	-20.6	16.7	95	-79	21
Fort McMurray	-9.9	1.2	10.9	37.9	48.7	57.0	62.1	58.3	50.0	36.3	15.4	-4.5	30.4			
Fort McPherson	-20.6	-14.0	-5.8	11.0	33.8	53.0	58.8	53.4	38.1	17.9	-7.6	-16.1	16.8	92	-62	19
Fort Norman	-18.6	-13.0	-2.4	19.4	40.8	54.2	59.2	53.8	41.2	24.2	-1.2	-15.0	20.2	92	-62	21
Fort Resolution	-16.9	-10.0	-1.7	21.1	40.0	51.8	60.2	56.0	45.5	31.6	8.3	-10.0	23.0	90	-63	15
Fort Simpson	-19.1	-11.7	0.1	27.0	44.1	55.6	61.5	56.8	45.0	28.8	3.7	-12.6	23.4			31
Fort Smith	-15.6	-9.8	1.4	25.4	43.2	53.2	59.8	55.4	44.3	29.6	10.2	-10.2	23.9	93	-71	16
Fort Channel	-24.2	-25.4	-17.5	2.1	23.2	30.4	39.9	35.4	27.7	12.7	-7.1	-20.7	6.6			
Godhavn	2.1	-1.2	3.7	14.0	30.6	40.3	45.5	44.4	36.5	29.1	20.7	12.6	23.0	63	-28	8
Godthaab	14.4	13.8	18.5	24.8	33.4	39.9	43.7	43.3	37.8	30.6	23.7	17.8	28.6	76	-20	50
Goose Fiord	-36.0	-26.0	-30.0	-13.0	11.0	33.0	40.0	34.0	15.0	-2.0	-15.0	-26.0	-1.0	56	-61	2
Great Falls	23.6	25.0	33.8	45.6	54.4	62.1	69.4	67.1	56.9	47.6	35.6	27.7	45.8	106	-44	50
Hay River	-15.4	-11.0	0.4	23.2	39.4	50.0	59.6	56.8	46.4	32.1	8.8	-6.2	23.7	96	-62	36
Herschel Island	-22.0	-12.3	-12.1	2.1	19.2	35.5	44.1	41.3	31.3	16.0	-6.1	-14.5	10.2	69	-52	7
Ikerasak	-2.0	-5.4	0.9	12.6	30.9	41.0	46.9	44.6	35.4	25.3	17.2	7.0	21.2			16
Interior Greenland*	-33.2	-35.5	-30.1	-11.0	14.9	33.3	37.8	34.5	16.5	-7.2	-18.9	-24.3	-1.8			
Ivigtut	18.7	19.2	23.9	31.1	40.1	46.4	49.8	47.5	41.0	34.0	26.8	24.4	33.4	86	-20	46
Jakobshavn	0.1	-2.4	3.4	14.7	31.5	40.6	45.7	43.9	35.4	25.3	16.5	8.8	21.9	71	-46	50
Jan Mayen	22.8	21.9	20.7	25.2	29.7	36.1	40.5	41.7	38.1	31.8	27.0	23.5	29.8	59	-2	11
Jones Sound	-33.2	-20.2	-25.6	-10.5	13.1	34.2	40.0	18.7	14.8	-1.8	-14.4	-22.7	-0.6	56	-60	3

* Average of 5 expeditions.

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Table 63 (cont.)

Mean Monthly and Annual Temperature (°F.) with Absolute Extremes:
North American Arctic (cont.)

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Abs. Max.	Abs. Min.	Yrs. Rec.
Julianehaab	17.2	18.1	23.5	30.9	39.0	43.2	45.3	45.3	40.6	33.8	25.7	20.3	32.0			45
Juneau	27.7	30.0	33.7	40.7	47.7	54.2	56.7	55.3	50.4	43.3	35.7	30.9	42.2	89	-15	46
Kane Basin	-27.8	-25.8	-25.1	-7.8	17.2	34.0	39.6	34.3	18.0	1.2	-12.3	-20.2	2.1			
Lady Franklin Bay	-33.9	-36.9	-27.9	-11.2	16.0	32.4	37.2	34.7	14.5	-8.7	-22.0	-26.9	-2.7			
Lake Harbour	-15.4	-11.4	-4.9	8.8	27.7	37.8	44.0	41.4	35.0	24.6	12.4	-4.0	16.4	74	-45	24
Le Pas	-6.5	-0.6	8.2	32.7	46.8	57.9	63.0	59.5	49.6	37.2	17.6	1.9	30.6			21
Martins Falls	-8.7	-5.4	8.5	29.2	42.6	55.8	61.5	57.8	48.0	36.0	18.8	1.5	28.8	99	-54	30
Mistassini Post	-5.8	-2.4	14.1	28.8	42.1	54.5	60.4	56.6	48.4	37.0	21.2	3.0	29.8	91	-56	7
Moose Factory	-4.4	-2.0	9.9	28.0	42.4	54.2	61.2	58.5	51.1	39.2	22.3	4.6	30.4	97	-54	33
Mygg-Bukta	-4.5	-6.5	-5.6	2.5	19.4	32.7	38.7	37.4	29.3	14.5	3.9	-2.0	13.1	69	-48	6
Nome	3.2	5.3	8.5	18.9	33.9	45.5	49.9	49.5	41.5	29.2	15.6	7.2	25.7	84	-47	33
Norway House	-10.1	-4.5	9.5	29.1	44.4	56.3	63.0	59.7	48.4	36.5	16.7	-1.5	28.9			32
Pangnirtung	-20.9	-13.5	-6.5	7.7	23.7	37.4	46.0	45.1	37.4	25.9	13.2	-7.1	15.8	71	-46	3-5
Pond Inlet	-29.2	-29.4	-21.9	2.2	23.4	38.3	42.2	40.9	30.0	13.4	-4.2	-19.0	7.2	77	-54	6
Port Harrison	-18.5	-18.5	-6.2	11.6	29.2	39.0	47.1	46.9	41.0	30.2	18.1	-0.5	18.3	76	-57	8
Port Nelson	-16.7	-14.3	-1.5	16.9	32.9	45.1	55.1	53.4	44.3	30.4	10.4	-9.2	20.9	91	-55	15
Reykjavik	29.8	29.8	31.1	36.3	42.8	48.6	51.6	50.5	45.5	39.2	33.8	30.0	39.0			48
Scoresbysund	0.7	-1.7	1.8	9.7	24.1	35.2	40.1	37.9	31.6	19.4	9.1	4.1	17.6	63	-42	
Simpson Straight	-28.7	-31.4	-23.8	-2.9	16.0	34.7	43.5	41.2	29.3	13.4	-3.8	-24.3	5.0			
St. Paul Island	21.8	21.9	26.6	27.2	33.4	40.8	45.2	46.5	44.7	38.5	32.8	26.6	33.8	64	-26	10
Thule (North Star Bay)	-20.6	-20.9	-15.2	0.9	23.0	34.7	40.5	38.8	28.0	14.0	-0.4	-13.4	9.1			
Upernavik	-7.2	-9.8	-6.3	6.3	25.2	35.2	40.8	40.8	33.4	24.8	14.2	1.4	16.5	69	-44	50
Vancouver	35.6	38.3	42.2	47.6	53.9	59.0	63.3	62.3	56.4	49.4	42.7	38.3	49.1	92	2	28
Winnipeg	-3.4	0.6	15.3	37.8	52.1	62.4	66.6	64.1	54.0	40.9	21.7	6.0	34.8	103	-46	40
Winter Harbour	-30.9	-29.3	-13.5	-15.4	16.9	30.5	41.1	--	15.8	2.7	-17.1	-36.8	--	60	-56	1

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Table 64

Mean Monthly and Annual Temperatures (°F.) with Absolute Extremes:
Siberian Arctic

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Abs. Max.	Abs. Min.	Yrs. Rec.
Anadyr	-10.5	-6.0	-1.8	5.9	26.4	40.3	51.6	49.5	38.7	23.0	5.5	-6.0	18.0	75	-50	9
Archangel	8.1	9.7	17.4	30.0	41.4	52.7	59.5	55.2	45.7	33.8	21.4	12.2	30.3	94	-49	35
Ayan Island	-17.3	-20.6	-22.7	4.3	18.1	25.7	39.9	40.6	31.6	23.9	7.3	-10.7	10.0	72	-43	1
Barnaul	-0.6	2.3	14.9	33.6	52.3	63.7	68.0	63.0	51.8	35.8	16.9	5.0	33.9	96	-61	33
Bear Island	15.1	11.8	12.2	18.3	27.9	35.1	39.6	38.5	35.4	28.9	20.7	18.5	25.2			
Blagoveschensk	-24.0	-14.4	1.6	21.2	39.2	57.0	63.5	55.9	41.7	21.2	-2.2	-18.4	20.2	100	-66	26
Priisk	29.1	27.7	20.1	35.6	42.4	49.6	54.5	53.8	47.7	39.9	33.6	29.3	39.4	85	-4	60
Bodo	-40.0	-31.1	-15.7	4.6	25.0	47.7	52.7	48.6	34.0	11.3	-20.0	-32.1	7.0	86	-75	7
Bulun	-24.4	-24.4	-26.4	7.7	15.0	29.0	34.9	36.8	27.9	9.6	-9.0	-17.6	4.9	67	-50	2
Cape Chelyuskin	-4.0	-6.3	-0.9	6.8	28.2	37.8	41.7	30.6	22.5	7.3	-10.8	-12.5	11.7	53	-43	1
Cape Serdze Kamen	-19.9	-15.2	-10.2	-3.8	18.2	34.0	39.4	37.0	30.9	17.4	-0.8	-8.3	10.1	75	-46	3
Cape Schmidt	-13.5	-11.7	-10.8	0.1	17.2	32.0	40.3	41.4	35.4	20.5	1.2	-10.3	11.8	73	-55	
Dickson Island	-15.5	-10.7	-17.1	-7.2	14.5	29.3	33.4	32.7	27.7	13.3	-3.6	-15.5	6.8	43	-52	4
Domashnii Island	-20.7	-14.8	-10.7	3.9	21.6	41.7	56.3	53.1	38.7	16.2	-6.0	-16.4	13.6	84	-70	17
Dudinka	-33.0	-20.7	-3.1	20.7	41.4	60.1	66.7	58.1	41.5	20.7	-10.6	-31.0	17.6	103	-75	13
Elgiai	-18.4	-26.0	-16.2	-7.2	21.4	32.7	34.5	32.2	24.4	10.9	-11.9	-10.8	5.5	52	-51	1
Four Pillar Island	-32.1	-32.4	-22.5	-9.0	12.2	28.8	32.2	28.8	15.8	7.0	-19.7	-26.0	-2.6	37	-62	
"Fram"	25.3	24.3	26.1	31.1	36.7	44.6	49.8	50.0	43.7	35.8	29.7	26.2	35.3			
Gjesvar	-23.1	-23.6	-19.5	7.4	14.9	32.4	37.8	36.6	30.9	14.0	-9.0	-18.6	5.5	72	-54	6
Lyakhovski Island	3.2	0.7	-2.2	7.3	23.4	35.4	41.7	40.5	32.2	21.2	10.9	6.8	18.5	60	-57	19
Green Harbor	5.3	5.6	11.5	24.2	36.0	48.5	53.5	50.2	40.5	26.7	15.9	7.7	27.1	90	-50	22
Karesuanda	3.7	4.6	12.4	25.3	36.9	49.3	55.0	51.1	41.7	28.4	13.6	5.2	27.3	90	-59	60
Karasjok	9.1	11.5	19.8	34.2	47.1	56.8	62.2	56.5	46.4	34.5	22.8	13.1	34.5	89	-45	33
Kargopol	-37.5	-32.2	-15.5	5.2	24.6	45.0	52.5	45.3	33.2	10.6	-17.3	-30.3	7.2	85	-63	
Kazachie	12.0	12.0	18.3	30.4	40.5	50.7	57.6	54.0	43.1	34.2	23.7	15.8	32.9	94	-41	35
Kem																

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Table 64 (cont.)

Mean Monthly and Annual Temperatures (°F.) with Absolute Extremes:
Siberian Arctic (cont.)

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Abs. Max.	Abs. Min.	Yrs. Rec.
Khatanga	-28.1	-22.4	-19.5	-4.9	21.9	39.2	53.6	47.8	35.4	13.3	-11.6	-15.5	9.1	84	-66	3
Kirensk	-18.0	-8.7	9.3	29.1	45.7	60.6	66.0	60.4	45.1	27.7	6.3	-12.5	25.9	95	-71	18
Kola	11.3	11.1	17.4	29.1	38.1	47.7	54.5	51.3	42.6	31.5	20.5	13.3	30.7		-39	
Krasnoyarsk	-0.8	4.5	16.9	33.6	48.9	61.2	66.7	61.5	49.6	33.3	15.8	5.5	33.1	103	-49	30
Leningrad	18.3	18.1	24.6	37.0	49.1	58.3	63.5	59.9	51.1	40.5	30.4	22.1	39.4	97	-49	35
Malye Karmakuly	2.3	3.0	4.8	13.5	24.6	34.9	43.7	43.2	35.2	25.9	12.6	6.3	20.8		-42	31
Markovo	-19.7	-14.3	-9.9	4.6	27.7	50.0	57.4	50.2	37.4	16.5	-3.5	-15.3	15.1	84	-72	25
Matochkin Strait	-3.3	-4.7	-0.6	7.2	21.2	32.2	41 7	41.2	30.9	23.5	5.7	-3.3	16.0			
"Maud"	-26.5	-21.6	-23.6	-7.4	10.0	28.9	32.0	31.3	20.8	6.6	-12.1	-21.1	1.4	37	-46	2
Moscow	12.6	15.6	23.4	38.1	53.2	60.1	64.4	60.4	50.2	38.9	27.0	17.6	38.4	100	-43	35
New Siberian Islands	-31.2	-30.1	-26.9	-7.2	15.6	35.3	36.0	30.4	20.3	3.6	-11.2	-14.6	1.4			2
Nizhne Kolymsk	-40.0	-30.8	-15.2	3.6	27.3	50.2	53.8	46.8	34.5	8.2	-11.7	-26.8	84.0	82	-57	6
Novaya Zemlya (Northern part)	-6.0	-9.0	-5.8	6.1	17.2	29.3	37.9	36.5	27.9	12.7	-0.6	-5.8	11.7			
Obdorsk	-14.1	-7.8	-0.4	13.1	28.0	44.8	56.8	52.0	41.0	23.3	2.1	-7.4	19.2	85	-65	33
Okhotsk	-10.3	-7.2	6.4	21.0	34.9	44.4	54.3	55.2	46.4	26.6	9.4	-7.4	22.5	78	-50	32
Olekminsk	31.7	-18.4	-0.9	22.5	42.3	58.5	66.0	58.3	44.4	23.5	-5.6	-25.8	19.4	95	-76	30
Perm	3.2	9.0	19.4	35.2	50.0	59.2	64.4	59.2	48.2	33.8	18.7	8.4	34.1	94	-47	33
Quady Hook	6.6	3.7	5.5	11.5	24.1	34.9	40.1	39.0	31.8	21.4	11.8	9.7	20.0			
Riga	25.0	25.0	31.0	42.0	53.0	60.0	64.0	61.0	53.0	44.0	35.0	27.0	43.0	93	-20	43
Rodchevo	-38.9	-32.6	-17.3	7.5	36.7	55.8	61.5	50.0	37.8	12.9	-15.5	-33.2	10.4	91	-67	8
Russkoe Uste	-36.4	-33.0	-23.4	-7.8	19.9	40.3	51.3	42.3	31.3	9.0	-13.7	-27.4	4.4	85	-64	9
Sagastyr Island	-30.4	-34.2	-29.4	-7.6	13.3	32.1	42.4	41.6	32.4	5.1	-15.8	-28.6	1.8	72	-64	12
Semenovsky Rudnik	-20.6	-18.8	-12.5	4.5	20.8	41.9	46.9	42.1	32.9	12.2	-11.6	-13.5	10.4			1
Skara	25.6	24.6	29.5	38.2	48.0	56.6	59.6	57.0	50.4	40.6	33.0	28.0	40.9	91	-26	30
Sredne Kolymsk	-39.8	-32.8	-16.8	5.0	30.2	54.7	57.2	49.5	36.5	11.8	-18.2	-34.1	8.6	94	-72	13

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Table 64 (cont.)

Mean Monthly and Annual Temperatures (°F.) with Absolute Extremes:
Siberian Arctic (cont.)

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Abs. Max.	Abs. Min.	Yrs. Rec.
Surgut	-11.0	-2.2	9.7	23.7	38.5	54.3	63.5	58.1	46.4	28.2	6.8	-5.1	25.9	90	-67	24
Taimyr Pen. (western part)	-29.9	-20.0	-15.2	-0.8	17.8	33.6	37.0	36.0	23.5	12.2	-4.4	-18.4	5.9	--	--	2
Tikhaja Bay	3.2	0.1	-5.4	4.3	19.6	--	--	--	27.1	16.0	5.2	-1.8	--	--	--	2
Tobolsk	-4.4	4.3	16.2	32.9	48.9	60.3	65.3	60.4	49.3	32.7	13.5	3.0	31.8	95	-51	22
Tromso	26.2	24.8	26.4	32.0	38.8	47.1	51.8	50.7	44.2	36.1	30.4	26.6	36.3	82	-1	60
Trondheim	27.3	27.9	30.6	38.3	45.9	53.6	57.2	55.4	48.9	40.5	33.1	27.7	40.5	95	-15	60
Turukhansk	-17.9	-10.1	2.3	14.7	31.1	48.4	61.3	55.0	41.2	20.3	-4.4	-17.1	18.7	91	-78	46
Uedineniya Island	-0.2	-2.9	11.7	1.8	17.6	--	--	--	32.0	22.8	5.2	-1.8	--	--	--	
Uelen	-4.7	-7.7	-2.6	8.0	28.8	34.7	41.8	40.3	35.3	24.0	10.4	1.4	16.9	67	-48	6
Vaigach	3.1	2.5	-0.6	8.8	22.5	34.3	42.2	42.0	38.1	29.1	18.9	7.9	20.7	79	-44	15
Vardo	22.1	21.4	23.5	29.5	35.1	42.3	47.7	47.8	43.2	34.9	28.2	24.1	33.3	78	-11	60
Verkhoyansk	-58.2	-48.1	-23.8	9.3	36.3	56.1	60.3	51.6	36.1	5.7	-34.1	-51.3	3.3	94	-90	
Wrangel Island	-10.7	-13.6	-10.1	0.6	16.7	32.7	37.0	35.6	28.5	16.3	1.4	-5.3	10.8	65	-50	9
Yakutsk	-45.9	-33.2	-9.2	16.7	41.4	59.5	66.4	58.8	42.6	16.7	-19.7	-40.4	12.8	100	-84	71
Yugorski Strait	-1.0	-2.0	-2.2	8.8	21.8	35.0	43.0	43.4	38.3	27.2	15.6	3.6	19.2	78	-47	20

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PRECIPITATION

There are two significant factors which make it extremely difficult to obtain satisfactory measurements of precipitation in the Arctic: first, the fine ice needles of winter precipitation are very easily blown across the rain gage opening and, secondly, during snow storms it is difficult to determine whether the snow is falling or is being whirled up from the ground. Another obstacle is determining the number of days with a measureable amount of precipitation. On extremely cold days the snow is very fine and there are many days when precipitation is so slight that it cannot be measured but is present nevertheless. A striking example is found in records of the Norwegian North Polar Expedition. At Goose Fiord, Ellesmere Island, 11 days in April were recorded on which precipitation occurred but the total for the month showed only 0.2 mm. or slightly less than 0.01 inch. On the North American Continent the number of days with precipitation are determined from the days on which 0.01 inch or more is measured. Other stations use days with 0.1 mm. or more, while still other stations have tabulated all the days when precipitation occurred. In the frequency tables, 69 and 70, the system used is indicated whenever it could be determined. Also, brevity of some of the records might introduce values which are too high or too low. These limitations must be kept in mind in making comparisons among stations in these tables.

In the Arctic and sub-Arctic regions the inadequacy of the records permits us to make only broad and general statements regarding yearly averages and seasonal distribution. The time of year of maximum precipitation varies with the prominence of marine or continental influence. It is a well known fact that snowfall is extremely light and as is seen from the precipitation chart, figure 58, stations in continental areas have maximum precipitation in late summer, indicating that a large percent of the yearly total falls as rain.

On the whole, amounts of precipitation received at land stations are rather uniform, which is as might be expected in countries of monotonous relief. This is especially true in the north central portion of Siberia. Variation of the annual amounts from year to year is also slight. Snowfall varies more than rainfall, especially where it is comparatively scarce. Depth of snow for any month may exceed four times the average fall, whereas rain seldom exceeds twice the normal amount.

Although the amount of precipitation received along the Arctic coast is small, the ground remains soaked for a long period in summer. Underground drainage is prevented by the permanently frozen subsoil. Even though somewhat larger amounts of precipitation are received farther south at inland stations, the summer temperatures are so much higher that drouth conditions become manifest.

The precipitation chart, 58, contains the annual isohyets for ten and twenty inches, with bar graphs showing monthly amounts of precipitation at selected stations. Filling in gaps where data are scarce, we can make the following conclusions with some degree of certainty. 1. The amount of precipitation decreases considerably toward the Pole, especially in winter. 2. In precipitation, as in temperature, interzonal differences are apparent. In the Canadian Archipelago and on the north coast of Asia

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summer precipitation is greater than that of winter, but in the North Sea low pressure area, between the east coast of Greenland and Novaya Zemlya, averages are greater in winter than in summer. 3. In the region of the North Sea Low and the low pressure spur in Baffin Bay the annual amounts of precipitation are greater than in the other regions of equal geographical latitude.

In table 73, the record of the "Maud" shows that snow may fall in every month and that rain falls only in June, July, August, and September. May has, on the whole, the greatest number of days with precipitation and the midwinter months the smallest. The contrast between conditions in summer and winter appear to be greater in the pack ice than at the coast.

No diurnal variation was found in winter in the pack ice but in other seasons of the year the probability of precipitation appears to be greater at night than in the daytime. The difference is especially great in spring, but apparently there is no satisfactory explanation of this feature. It was also found that the probability of precipitation was greater with northerly than with southerly winds. This is also true of the coast as the land elevations would favor precipitation with onshore winds. In table 66, monthly averages are shown for the two years the "Maud" was in the pack ice. The results were similar to those found on the "Fram." Also, the most probable average for the pack ice computed from all available data is found in the table.

The frequency of precipitation varies, in general, with the total precipitation. Koeppe suggests that at least two-thirds of the Dominion of Canada probably has fewer than 80 days per year with measurable amounts (0.01 inch or more). This area embraces nearly all the Arctic region of North America. The number of days with precipitation in the North American Archipelago is particularly small in winter. A maximum frequency occurs in the region of the North Sea Low in October and November, while on the Asiatic Russian north coast the maximum appears in September, though the period of heaviest precipitation is more generally July and August.

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Table 65

Mean Monthly and Annual Amounts of Precipitation (in.):
North American Arctic

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Yrs. Rec.
Aklavik	.57	.55	.38	.51	.59	.67	1.30	1.00	1.00	.97	.73	.46	8.73	8
Anchorage	.84	.69	.56	.37	.49	.62	1.65	2.71	2.55	2.17	1.03	.85	14.53	
Anmagssalik	3.27	2.01	2.44	2.40	2.40	2.09	1.93	2.36	3.70	5.67	3.31	2.76	34.34	28
Atlin	1.01	.82	.60	.33	.43	.77	1.01	.92	1.23	1.19	1.19	1.19	10.69	22
Barrow	.15	.21	.14	.12	.14	.26	.92	.72	.48	.58	.31	.27	4.29	24
Calgary	.47	.63	.83	.94	2.12	3.23	2.56	2.29	1.53	.63	.75	.55	16.53	50
Chesterfield	.35	.61	.72	.74	.52	.94	2.35	1.85	1.98	1.24	.85	.86	13.01	4-7
Churchill	.62	.98	1.11	.99	.97	1.98	1.79	2.51	2.60	1.27	1.16	.86	16.84	
Coppermine	.44	.56	.73	.82	.52	.86	1.34	1.76	1.19	1.01	.80	.53	10.46	5
Craig Harbour	.69	.27	.56	.62	.37	.71	.89	2.16	.54	1.18	1.01	.31	9.31	3-4
Cumberland Sound	.31	.31	.55	.51	.75	2.28	3.39	1.18	2.17	.59	.91	.75	13.70	
Danmarkshavn	1.22	.71	.71	.12	.16	.20	.04	.31	.28	.24	1.02	.75	5.76	2
Dawson	.83	.71	.53	.57	.91	1.22	1.54	1.42	1.46	1.14	1.16	1.00	12.49	30
Dutch Harbor	5.85	5.63	4.88	3.91	4.24	2.74	1.91	2.43	5.32	7.30	5.66	.70	56.88	20
Edmonton	.76	.67	.67	.80	1.86	3.26	3.56	2.47	1.40	.74	.73	.75	17.67	40
Etah	.11	.06	.22	.31	.07	.01	---	--	.30	.27	.53	.25	2.13	1
Fairbanks	.96	.48	.69	.28	.58	1.33	1.92	2.08	1.30	.85	.74	.61	11.82	10 mos.
Fargo	.30	.34	.88	2.00	2.57	3.70	3.53	3.07	1.90	1.89	.53	.27	20.98	16
Fond du Lac	.53	.26	.27	.15	.58	1.22	1.73	2.09	1.38	.76	.74	.55	10.26	24
Fort Chipewyan	.68	.54	.68	.69	.83	1.36	2.31	1.63	1.22	.91	.94	.80	12.59	45
Fort Congor	.42	.13	.44	.17	.40	.18	.66	.38	.35	.24	.20	.30	3.88	3
Fort George	1.50	.71	.91	2.36	1.73	1.22	2.56	2.13	1.89	1.30	.59	.79	17.69	11
Fort Good Hope	.47	.54	.59	.54	.64	1.02	1.39	1.63	1.15	1.04	.72	.52	10.25	21
Fort McMurray	1.44	.58	.92	.44	1.55	2.02	2.89	2.00	2.16	1.17	.82	1.02	17.01	
Fort McPherson	.68	.49	.46	.80	.44	1.02	1.18	1.82	1.14	.81	.67	.77	10.28	19

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Table 65 (cont.)

Mean Monthly and Annual Amounts of Precipitation (in.):
North American Arctic (cont.)

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Yrs. Rec.
ort Norman	.39	.48	.54	.49	1.09	1.33	1.85	1.94	1.01	.85	.36	.37	10.70	21
ort Resolution	.58	.61	.56	.37	.87	1.21	1.05	1.36	1.51	1.21	1.30	.63	11.26	15
ort Simpson	.62	.73	.49	.79	1.40	1.60	1.78	1.45	1.68	1.32	.73	.86	13.45	
ort Smith	.57	.52	.29	.33	.87	1.79	1.66	1.69	1.51	.91	.70	.50	11.34	16
Godhavn	.59	.51	.71	.59	1.50	1.18	2.68	2.01	1.69	1.38	1.34	.98	15.16	8
Godthaab	1.42	1.69	1.69	1.22	1.69	1.42	2.17	3.07	3.27	2.48	1.93	1.46	23.51	50
Great Falls	.61	.55	.86	1.15	2.24	3.13	1.51	1.17	1.44	.86	.68	.65	14.85	50
Hay River	.62	.55	.50	.57	.83	1.16	1.35	1.73	1.56	.90	.78	.76	11.31	36
Ivigtut	3.31	2.60	3.35	2.52	3.50	3.19	3.07	3.78	5.79	5.67	4.65	3.19	44.62	50
Jakobshavn	.35	.28	.39	.51	.59	.83	1.26	1.42	1.26	.91	.71	.51	9.02	50
Jan Mayen	1.54	1.69	1.10	.94	.51	.59	.79	1.06	2.52	2.20	1.42	.98	15.34	7
Juneau	7.18	5.62	5.49	5.40	5.25	4.01	5.09	7.51	10.26	11.31	9.14	7.63	83.89	46
Lake Harbour	1.36	.95	.97	1.18	1.06	.47	.89	.74	1.19	2.20	2.62	1.80	15.34	8
Le Pas	.54	.53	.57	.70	1.36	2.22	2.32	2.08	1.81	1.10	.80	.54	14.57	
Martins Falls	.87	.45	.79	.32	1.45	2.42	2.31	1.99	2.25	1.28	1.02	.89	16.04	30
Mistassini Post	2.36	2.09	1.65	2.18	2.54	3.60	3.74	3.05	2.94	2.76	2.06	2.80	31.77	
Moose Factory	1.14	.59	1.40	.85	2.25	2.61	2.60	3.15	3.21	1.81	1.89	1.52	23.02	
Mygg-Bukta	.20	.43	.20	.16	.04	.24	.47	.43	.04	.20	.43	.24	3.08	
Nome	1.14	.83	.87	.67	.65	1.18	2.53	3.35	2.74	1.58	.97	1.12	17.63	30
Norway House	.69	.73	1.03	.72	1.31	2.23	2.45	2.63	2.76	.84	1.12	.82	17.33	21
Pangnirtung	.94	1.65	1.00	1.83	.70	1.04	1.96	2.22	1.13	1.53	1.61	2.15	17.76	4-7
Pond Inlet	.25	.10	.09	.21	.36	.43	1.51	1.00	.86	.56	.47	.39	6.23	5
Port Harrison	.47	.35	.28	.51	.55	.55	.83	1.42	1.54	.87	.67	.59	8.63	
Port Nelson	.60	.46	.58	.88	.85	2.07	1.64	2.08	1.79	.96	1.04	.81	13.76	15
Resolution Island	1.18	1.46	.98	1.26	1.57	1.42	2.40	1.81	2.13	.87	1.34	1.65	18.07	
Reykjavik	3.86	3.31	2.72	2.44	1.89	1.93	1.89	2.01	3.54	3.43	3.74	3.50	34.26	50

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Table 65 (cont.)

Mean Monthly and Annual Amounts of Precipitation (in.):
North American Arctic (cont.)

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Yrs. Rec.
Scoresbysund	1.77	1.69	.55	1.50	.28	.98	.55	.43	1.06	1.10	1.02	1.54	12.47	
Simpson Strait	.24	.16	.32	.24	.47	.20	.35	.83	.71	.39	.35	.12	4.38	
St. Paul Island	2.22	1.59	1.84	1.38	1.50	1.37	2.70	3.25	3.43	3.26	2.88	2.17	27.59	
Thule	.09	.09	.21	.09	.20	.32	.75	.71	.34	.10	.27	.16	3.33	1-5
Upernavik	.43	.43	.63	.55	.59	.59	.98	1.10	1.02	1.14	1.06	.51	9.03	5
Vancouver	8.40	6.03	4.98	3.29	2.99	2.57	1.23	1.70	4.07	5.65	9.32	8.22	58.65	40
Winnipeg	.87	.84	1.13	1.34	2.19	3.08	3.07	2.34	2.26	1.48	1.08	.91	20.59	1
Winter Harbour	.91	.79	.94	.43	1.46	--	--	--	.94	.39	.32	.16	---	

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Table 66

Mean Monthly and Annual Amounts of Precipitation (in.): Siberian Arctic

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Anr	Yrs. Rec.
Anadyr	.32	.32	.24	.20	.35	.94	1.22	1.54	1.14	.51	.24	.35	7.41	16
Archangel	89	.78	.90	.78	1.43	2 01	2.37	2.53	2 24	1.78	1.27	1.05	18.03	45
Barnaul	.75	.51	.55	.59	1.26	1.73	2.13	1.77	1.14	1.20	1.06	1.02	13.77	75
Bear Island	1.1	1.42	1.18	.67	.75	.79	.67	.91	1.57	1.34	.98	1.14	12.52	
Blagoveschensk Priisk	66	31	.60	.45	.87	1 08	1.97	1.94	1.34	.85	1.07	1.18	12.36	7
Bulun	31	.24	.28	.35	.47	1.02	1.54	1.61	1.45	.94	.39	.32	8.93	18
Cape Cheliuskin	.18	.17	.07	.04	.11	1.26	.96	.77	.34	.23	.29	.21	4.53	1
Cape Schmidt	.14	.36	.49	.52	.23	37	.83	1.79	.80	.74	.17	.24	6.83	3
Dickson Island	.16	.16	.16	.28	.24	63	.98	1.46	1.13	.47	.35	.20	6.27	
Domashnii Island	.13	.14	.09	.04	.15	.20	1.27	.62	.50	.21	.09	.13	3.57	
Dudinka	.20	.22	.18	.29	.43	1.17	1.26	1.70	1.65	.72	.33	.24	8.40	17
Elgiai	.58	.29	.20	.37	.60	1.31	.81	1.39	1.05	.60	.70	.49	8.39	12
Gjesvar	2.64	3.15	2.80	2.24	2.09	2.20	2.83	2.60	3.82	3.40	3.43	2.87	34.13	
Lyakhovski Island	.12	.08	.08	.04	.16	.43	.55	.71	.47	.24	.08	.08	3.04	7
Green Harbor	1.31	1.24	1.06	.93	.48	.47	.68	.83	.92	1.20	.99	1.57	11.68	14
Karesuando	.48	.37	.27	.32	.77	1.26	2.90	2.44	1.32	.89	.65	.43	12.10	32
Karasjok	.71	.75	.51	.55	.94	1.69	2.40	2.09	1.85	1.18	.98	.67	14.32	50
Kargapol	1.10	1.10	1.10	.94	1.85	1.93	2.80	2.96	2.13	1.77	1.34	1.22	20.27	25
Kazachie	.18	.22	.13	.18	.33	1.16	1.05	1.05	.82	.38	.35	.29	6.14	7
Kem	.79	.63	.67	.87	1.18	2.01	2.64	2.87	2.68	1.93	1.18	.91	18.36	25
Khatanga	.24	.33	.28	.50	.68	.76	1.63	1.76	1.06	.77	.44	.61	9.06	3
Kirensk	.79	.51	.47	.51	1.10	1.93	2.05	2.09	1.73	.98	.94	.98	14.08	13
Kola	.55	.75	.51	.67	1.10	1.42	2 20	1.93	1.65	1.22	1.18	.83	14.01	25
Krasnoyarsk	.24	.24	.24	.43	1.14	1.73	2.05	2.64	1.42	.87	.63	.47	12.10	22
Leningrad	1.07	.95	.92	1.23	1.62	2.14	2.33	3.25	2.37	1.81	1.43	1.28	20.44	40
Malye Karmakuly	.28	.28	.35	.28	.51	.75	1.26	1.65	1.77	1.38	.51	.39	9.41	13
Markovo	.32	.28	.30	.15	.32	.77	1.47	1.91	1.07	.48	.46	.37	7.90	21

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Table 66 (cont.)

Mean Monthly and Annual Amounts of Precipitation (in.): Siberian Arctic (cont.)

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Yrs. Rec.
"Maud"	.12	.28	.16	.08	.32	.43	.67	1.02	.28	.16	.16	.20	3.88	2
Moscow	1.35	1.21	1.38	1.37	1.78	2.65	3.18	3.06	2.15	2.07	1.73	1.58	23.49	36
Nizhne-Kolymsk	.47	.25	.18	.22	.20	.66	1.48	1.20	.85	.50	.42	.29	6.72	7
Obdorsk	.29	.32	.24	.32	.67	1.26	1.85	1.97	1.46	.71	.47	.39	9.95	30
Okhotsk	.08	.09	.17	.35	.80	1.69	2.31	2.42	2.10	.96	.15	.11	11.23	18
Olekminsk	.39	.32	.24	.39	.94	1.69	1.57	2.09	1.30	.67	.67	.47	10.74	26
"Pack Ice"	.13	.20	.17	.12	.33	.45	.69	1.03	.26	.22	.19	.26	4.05	
Perm	1.45	1.17	1.15	1.09	2.00	2.73	2.78	2.87	2.32	1.89	2.06	1.70	23.21	33
Quady Kook	1.06	1.10	.91	1.10	.39	.55	.59	1.61	1.26	1.02	1.46	1.30	12.35	
Rodchevo	.59	.41	.25	.19	.46	.87	2.44	1.66	1.11	.42	.76	.63	9.79	10
Russkoe Usto	.15	.23	.24	.12	.47	.88	1.13	1.15	.64	.30	.36	.27	5.94	9
Sagastyr	.08	.08	Tr.	Tr.	.24	.43	.28	1.42	.43	.08	.16	.20	3.40	2
Semenovsky Rudnik	.02	.05	.02	.15	.69	1.63	1.08	1.72	.39	.57	.06	.07	6.45	1
Sredne Kolymsk	.34	.35	.17	.18	.24	.87	1.34	1.16	.76	.52	.48	.44	6.85	13
Surgut	.59	.39	.47	.51	1.30	2.52	2.44	3.19	1.89	1.30	.83	.71	16.14	28
Tiksi Bay	.08	.08	.12	.04	.08	.55	1.69	.83	.83	.24	.20	.08	4.82	3
Tobolsk	.63	.55	.63	.67	1.54	2.32	2.87	2.68	1.73	1.34	1.06	.91	16.93	35
Tromso	4.61	4.13	3.23	2.44	1.97	2.13	2.48	2.83	4.57	4.61	4.37	3.98	41.35	40
Trondheim	3.42	2.87	2.24	1.81	1.50	1.73	2.24	2.95	3.27	3.39	2.11	2.56	31.09	50
Turukhansk	.47	.37	.43	.55	1.02	1.61	1.97	2.27	2.02	1.15	.77	.55	13.18	40
Uclen	.63	.56	.39	.49	.43	.50	1.61	1.79	2.09	1.85	.54	.96	11.84	8
Vaigach	.32	.24	.20	.20	.32	.75	1.10	1.34	1.26	.33	.43	.35	7.34	18
Vardo	2.64	2.83	2.05	1.65	1.38	1.57	1.73	2.01	2.40	2.48	2.52	2.56	25.86	50
Verkhoyansk	.16	.13	.10	.16	.26	.88	1.05	1.04	.51	.33	.28	.15	5.05	27
Wrangel Island	.43	.24	.29	.24	.31	.53	.89	.89	.64	.50	.27	.23	5.46	9
Yakutsk	.24	.20	.13	.25	.50	1.07	1.32	1.64	.89	.47	.38	.28	7.37	36
Yugorski Strait	.28	.20	.20	.16	.39	.79	1.02	1.38	1.34	.87	.32	.28	7.23	20

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Table 67

Highest and Lowest Monthly Amounts of Precipitation (in.): North American Arctic

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yrs. Rec.
Aklavik													8-11
Highest	1.00	1.05	1.20	1.22	2.21	1.99	2.41	2.60	2.02	2.93	2.24	1.76	
Lowest	.05	.01	.05	.01	.02	.19	.53	.19	.22	.07	.02	.00	37
Angmagssalik													
Highest	10.98	16.06	11.54	7.01	9.17	4.09	6.77	6.06	8.94	18.58	11.06	9.13	
Lowest	.39	.31	.59	.28	.12	.12	.12	.28	.24	.43	.43	.12	24
Barrow													
Highest	.88	1.02	.51	.55	.81	.63	2.44	1.66	1.15	1.65	1.09	1.10	
Lowest	.00	.00	.00	T	T	T	T	T	T	.05	T	.00	4-7
Chesterfield													
Highest	.94	1.53	1.65	1.26	1.06	2.64	5.94	3.54	2.80	2.72	1.93	1.61	
Lowest	.00	.04	.16	.16	.08	.59	.98	.39	.94	.28	.43	.31	18
Churchill													
Highest	1.90	3.40	2.40	3.10	2.40	5.74	3.66	8.49	5.15	2.50	3.50	1.40	
Lowest	.10	.05	.41	.29	.37	.10	.25	.28	.82	.34	.30	.30	4-7
Coppermine													
Highest	.74	2.10	1.95	3.45	.89	2.34	1.84	3.20	1.95	2.23	2.20	.90	
Lowest	.05	.06	.30	.10	.15	.15	.40	.64	.78	.13	.13	.21	3-4
Craig Harbour													
Highest	1.81	.43	1.02	1.34	.55	1.30	1.77	3.90	.63	2.17	2.56	.39	
Lowest	.16	.04	.04	.12	.20	.16	.39	1.06	.39	.31	.20	.24	38
Edmonton													
Highest	2.49	2.33	1.93	2.60	7.67	8.53	11.13	6.43	4.32	2.28	3.57	3.21	
Lowest	.05	T	T	.01	.19	T	.15	.17	T	T	T	T	34
Fairbanks													
Highest	6.71	1.77	3.72	.98	1.38	3.25	5.39	6.88	5.61	3.40	4.65	1.73	
Lowest	.05	.00	T	.01	.02	.30	.12	.63	.09	T	.11	.11	

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Table 67 (cont.)

Highest and Lowest Monthly Amounts of Precipitation (in): North American Arctic (cont.)

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yrs. Rec.
Fort Good Hope													17
Highest	1.81	.43	1.02	1.34	.55	1.30	1.77	3.90	.63	2.17	2.56	.39	
Lowest	.16	.04	.04	.12	.20	.16	.39	1.06	.39	.31	.20	.24	9-14
Fort Norman													
Highest	1.46	2.32	.75	1.26	1.97	3.07	3.07	5.04	2.99	2.44	2.01	1.50	
Lowest	.00	.00	.00	.00	.20	.75	1.02	.55	.12	.04	.00	.00	60
Ivigtut													
Highest	13.98	17.56	15.01	9.21	11.57	11.46	8.50	10.24	13.03	14.48	20.63	13.86	
Lowest	.08	.00	.04	.00	.00	.04	.08	.00	.91	.91	.08	.00	60
Jakobshavn													
Highest	1.10	1.14	1.89	3.35	2.68	3.46	3.19	4.72	5.91	2.80	2.17	1.69	
Lowest	.04	.00	.00	.00	.00	.04	.04	.00	.12	.08	.08	.00	16
Jan Mayen													
Highest	3.41	4.09	3.03	3.07	1.41	1.82	4.05	4.05	4.75	4.30	3.66	4.14	
Lowest	.47	.35	.55	.24	.12	.08	.39	.35	.82	.63	.31	.43	8
Lake Harbour													
Highest	2.10	2.10	1.90	2.10	2.10	1.14	2.61	2.51	1.98	4.20	5.96	6.60	
Lowest	.23	T	.18	.17	.35	.01	.14	.19	.15	.32	1.06	.60	6
Mygg-Bukta													
Highest	2.13	1.54	13.4	.79	1.38	1.46	2.05	3.03	3.54	2.09	1.18	1.89	
Lowest	.08	.08	.16	.00	.04	.00	.08	.04	.00	.00	.43	.04	30
Nome													
Highest	3.70	4.44	3.37	1.55	2.52	4.41	8.43	5.82	7.10	7.37	3.92	3.84	
Lowest	.00	.06	T	T	T	T	.49	1.07	.52	.16	.06	T	

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Table 67 (cont.)

Highest and Lowest Monthly Amounts of Precipitation (in.): North American Arctic (cont.)

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yrs. Rec.
Pangnirtung													4-7
Highest	2.05	8.11	3.23	7.20	1.50	1.85	3.94	5.12	2.13	2.56	4.29	7.09	
Lowest	.12	.16	.16	.39	.16	.39	.83	.51	.31	.28	.12	.31	
St. Paul Island													10
Highest	4.06	3.61	2.85	2.16	3.11	1.18	5.11	3.88	5.27	3.83	3.89	3.69	
Lowest	.80	.54	.42	.67	.89	.24	.32	1.34	1.79	1.03	.67	.08	
Upernavik													60
Highest	2.05	3.62	3.31	3.74	2.44	3.11	5.32	4.13	2.68	3.82	4.06	2.72	
Lowest	.00	.00	.00	.00	.00	.00	.00	.00	.00	.08	.00	.00	

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Table 68

Highest and Lowest Monthly Amounts of Precipitation (in.): Siberian Arctic

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov.	Dec	Yrs. Rec.
Archangel													45
Highest	2.24	1.81	1.84	1.86	3.48	4.72	4.88	5.12	4.17	3.98	2.99	2.07	
Lowest	.24	.00	.28	.08	.16	.24	.09	.16	.51	.43	.08	.24	
Cape Schmidt													4
Highest	.23	.90	1.00	1.29	.35	.67	1.98	1.61	.93	1.21	.24	.40	
Lowest	.10	.11	.27	.22	.14	.14	.35	1.47	.68	.15	.11	.12	
Dickson Island													10
Highest	.31	.29	.38	2.04	.61	1.38	2.16	2.62	1.78	.96	.62	.51	
Lowest	.07	.06	.06	.01	.08	.06	.16	.62	.53	.14	.18	.02	
Green Harbour													19
Highest	2.67	3.91	3.59	3.35	1.55	.98	1.71	1.94	2.23	2.66	2.93	5.19	
Lowest	.42	.44	.13	.14	.05	.08	.00	.06	.17	.15	.02	.45	
Malye Karmakuly													9
Highest	3.24	2.73	2.29	1.73	1.97	1.43	1.56	2.85	1.95	1.48	1.68	3.04	
Lowest	.09	.13	.06	.06	.20	.26	.08	.27	.49	.46	.47	.05	
Moscow													46
Highest	3.43	2.60	3.43	4.21	3.98	7.52	6.54	5.39	7.99	5.67	4.13	3.43	
Lowest	.24	.08	.18	.20	.35	.79	.67	.63	.20	.35	.56	.24	
Uelen													8
Highest	2.28	1.85	.67	.98	1.08	.94	2.11	2.64	4.70	6.18	.88	2.38	
Lowest	.09	.11	.19	.24	.06	.08	.86	1.20	.78	.70	.18	.38	
Vaigach													9
Highest	.97	.45	.59	.89	1.30	3.21	4.23	1.88	1.80	1.74	.98	1.83	
Lowest	.16	.05	.06	.00	.03	.36	.22	.37	.36	.17	.19	.15	

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Table 68 (cont.)

Highest and Lowest Monthly Amounts of Precipitation (in.): Siberian Arctic (cont.)

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yrs. Rec.
Vardo													44
Highest	5.68	5.51	6.12	2.93	3.29	4.12	3.99	6.97	5.77	6.50	5.19	6.71	
Lowest	.63	.26	.11	.24	.06	.42	.24	.32	.47	.61	.46	.54	
Verkhoyansk													33
Highest	.63	.41	.30	.67	.65	3.42	2.90	2.36	1.70	1.45	.95	.40	
Lowest	.00	.00	.00	.00	.00	.08	.00	.00	.00	.06	.00	.00	
Wrangel Island													12
Highest	1.81	.56	.60	.71	1.12	2.06	1.97	1.83	1.79	1.18	1.12	.84	
Lowest	.02	.05	.06	.05	.04	.12	.13	.31	.14	.11	.03	.03	

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Table 69

Mean Monthly and Annual Number of Days with Precipitation 0.01 Inch or More: North American Arctic

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Yrs. Rec.	
Aklavik	6	7	4	4	6	5	9	9	11	9	6	5	81	8	
Anchorage	7	6	5	4	6	6	10	16	13	11	7	6	97	16	
Barrow	1	1	1	1	1	2	7	6	6	4	2	2	34	10	
Chesterfield	2	2	2	2	4	5	7	7	8	7	5	4	55	11	
Churchill	4	5	5	8	7	10	10	11	12	12	10	7	101	6	
Coppermine	3	3	6	4	5	6	10	13	10	6	5	3	74	--	
Craig Harbour	5	3	5	4	7	7	6	8	7	9	8	4	73	5	
Dawson	9	7	6	4	8	12	11	11	10	9	11	10	108	10	
Dutch Harbor	22	18	20	19	19	13	13	12	18	23	21	21	219	15	
Edmonton	12	9	11	8	10	13	13	14	7	8	7	9	121	10	
Etah*	6	3	6	9	3	1	-	-	6	7	14	9	64	10	mos.
Fairbanks	10	6	5	4	9	10	13	15	10	11	10	7	110	10	
Fargo	9	8	8	9	11	12	9	9	9	7	6	8	105	50	
Fort Conger	6	4	12	6	10	5	9	7	10	8	4	6	87	2	
Fort Chipewyan	5	4	5	2	6	7	9	10	9	6	6	4	73	10	
Fort Good Hope	9	7	7	6	8	10	10	11	11	8	9	8	104	21	
Fort McPherson	4	4	3	4	3	5	7	8	6	7	3	4	57	7	
Fort Norman	5	4	4	4	6	6	8	7	7	8	4	4	67	13	
Fort Simpson	7	7	6	3	6	8	8	7	8	6	6	7	79	15	
Godthaab*	13	12	13	11	10	10	10	12	13	13	13	12	142	45	
Goose Fiord+	1	10	8	11	17	15	10	8	14	17	9	11	141	1	
Great Falls	7	6	7	8	10	11	8	6	7	5	5	6	86	39	
Ivigtut*	12	10	12	10	10	10	9	10	13	12	12	11	131	45	
Jakobshavn*	8	7	9	8	8	8	8	9	11	11	11	10	108	52	
Jan Mayen	19	19	15	15	11	9	11	8	15	15	17	18	174	-	
Juneau	18	15	18	18	18	15	17	19	20	23	20	20	221	46	

* 0.1 mm. or more.

\+ Note: Trace or more.

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Table 69 (cont.)

Mean Monthly and Annual Number of Days with Precipitation 0.01 Inch or More: North American Arctic (cont.)

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Yrs. Rec.
Lake Harbour	5	5	6	6	8	9	9	8	8	10	11	6	91	6
Le Pas	6	5	5	5	6	9	9	12	11	9	7	7	94	20
Nome	11	8	9	9	7	9	13	15	16	11	9	11	132	15
Norway House	6	7	4	7	7	10	10	12	9	10	15	10	108	10
Pond Inlet	3	1	2	2	2	4	6	6	4	5	4	4	43	5
Port Nelson	6	5	6	7	6	9	9	12	11	9	7	7	94	15
Resolution Island	9	11	10	13	15	12	12	11	15	14	14	12	148	16
St. Paul Island	18	14	16	14	13	13	17	19	21	21	20	18	204	19
Thule*	1	6	7	2	3	-	6	-	10	4	8	5	-	3
Upernavik*	4	4	6	5	7	6	7	8	10	11	10	6	84	50
Vancouver	20	16	18	14	11	9	6	7	9	14	19	21	164	10
Winter Harbour+	14	8	19	9	19	9	6	-	17	24	6	2	-	1

* 0.1 mm. or more.

\+ Note: Trace or more.

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Table 70

Mean Monthly and Annual Number of Days with Precipitation 0.01 Inch or More: Siberian Arctic

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Yrs. Rec.
Anadyr	10	10	9	7	9	9	11	12	9	8	10	9	113	15
Archangel	16	15	13	11	12	12	12	14	15	17	17	17	171	25
Barnaul	7	5	5	5	8	9	9	9	8	8	9	8	90	54
Bear Island	14	14	14	10	12	7	7	8	14	13	14	13	140	
Bulun	12	10	11	8	7	10	12	12	13	18	13	12	138	18
Cape Cheliuskin	8	13	3	3	4	15	12	16	15	9	13	10	121	1
Cape Schmidt	6	10	11	9	8	6	10	14	18	12	9	7	120	3
Dickson Island	8	10	10	10	10	12	12	16	17	15	13	9	142	
Domashnii Island	7	7	7	4	6	8	12	13	9	10	6	6	95	4
Dudinka	14	13	11	12	10	12	12	13	18	17	16	14	162	18
"Fram"	11	11	13	13	20	20	21	19	22	14	9	9	180	2
Gjesvar	16	17	18	16	16	14	13	13	19	20	19	17	198	
Iyakhovski Island	8	7	5	4	4	8	10	10	11	14	9	8	98	7
Green Harbor	12	12	12	10	7	6	6	6	9	11	11	12	114	
Kazachie	8	12	9	9	8	12	14	14	17	13	13	12	141	7
Kem	9	6	8	8	11	13	11	15	12	11	9	12	125	29
Kirensk	16	14	12	11	12	14	12	14	15	15	18	18	171	
Kola	13	13	12	13	16	15	15	16	18	17	17	14	179	25
Malye Karmakuly	11	13	11	11	14	14	12	15	17	19	14	13	164	18
Markovo	8	8	8	6	6	7	12	12	8	10	11	9	105	21
Matochkin Strait	16	13	13	10	6	10	5	15	14	12	14	16	145	2
"Maud"	2	8	6	6	19	17	14	17	16	13	6	6	130	2
Moscow	15	16	14	12	12	14	14	15	16	15	17	20	184	18
Nizhne Kolymsk	8	10	8	8	6	6	13	14	14	13	12	9	120	8
Obdorsk	5	6	6	6	12	9	9	9	11	9	8	7	95	
Olekminsk*	8	8	7	7	9	11	8	10	10	10	11	10	110	26
Rodchevo	17	15	10	6	7	10	14	15	13	16	18	19	162	20

* Days with 0.1 mm. (0.004 inch) or more.

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Table 70 (cont.)

Mean Monthly and Annual Number of Days with Precipitation 0.01 Inch or More: Siberian Arctic (cont.)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Yrs. Rec.
Russkoe Uste	4	6	5	4	11	13	12	13	13	9	9	6	107	9
Sagastyr Island	4	6	1	2	10	8	2	8	12	4	11	7	75	2
Semenovsky Rudnik	3	6	4	5	12	15	8	14	7	10	6	4	94	1
Sredne Kolymsk	8	9	7	5	6	8	10	11	12	11	11	10	107	5
Surgut	11	8	8	9	10	12	8	11	16	17	11	17	138	8
Tiksi Bay	9	9	7	5	4	10	11	12	14	12	9	6	108	3
Turukhansk	12	12	12	11	12	13	12	14	17	19	16	14	164	42
Uelen	8	7	8	8	5	4	10	12	14	12	12	10	110	8
Vaigach	14	12	11	11	9	9	12	13	15	17	14	14	151	18
Vardo	14	14	16	12	11	9	9	10	14	17	16	15	157	20
Verkhoyansk*	6	5	4	4	4	7	8	8	6	7	8	7	73	30
Wrangel Island	8	7	7	6	8	7	10	12	10	11	8	7	102	9
Yakutsk*	9	8	5	4	6	8	9	10	9	12	12	10	104	31
Yugorski Strait	13	10	11	10	12	11	12	16	19	20	16	16	165	

* Days with 0.1 mm. (0.004 inches) or more.

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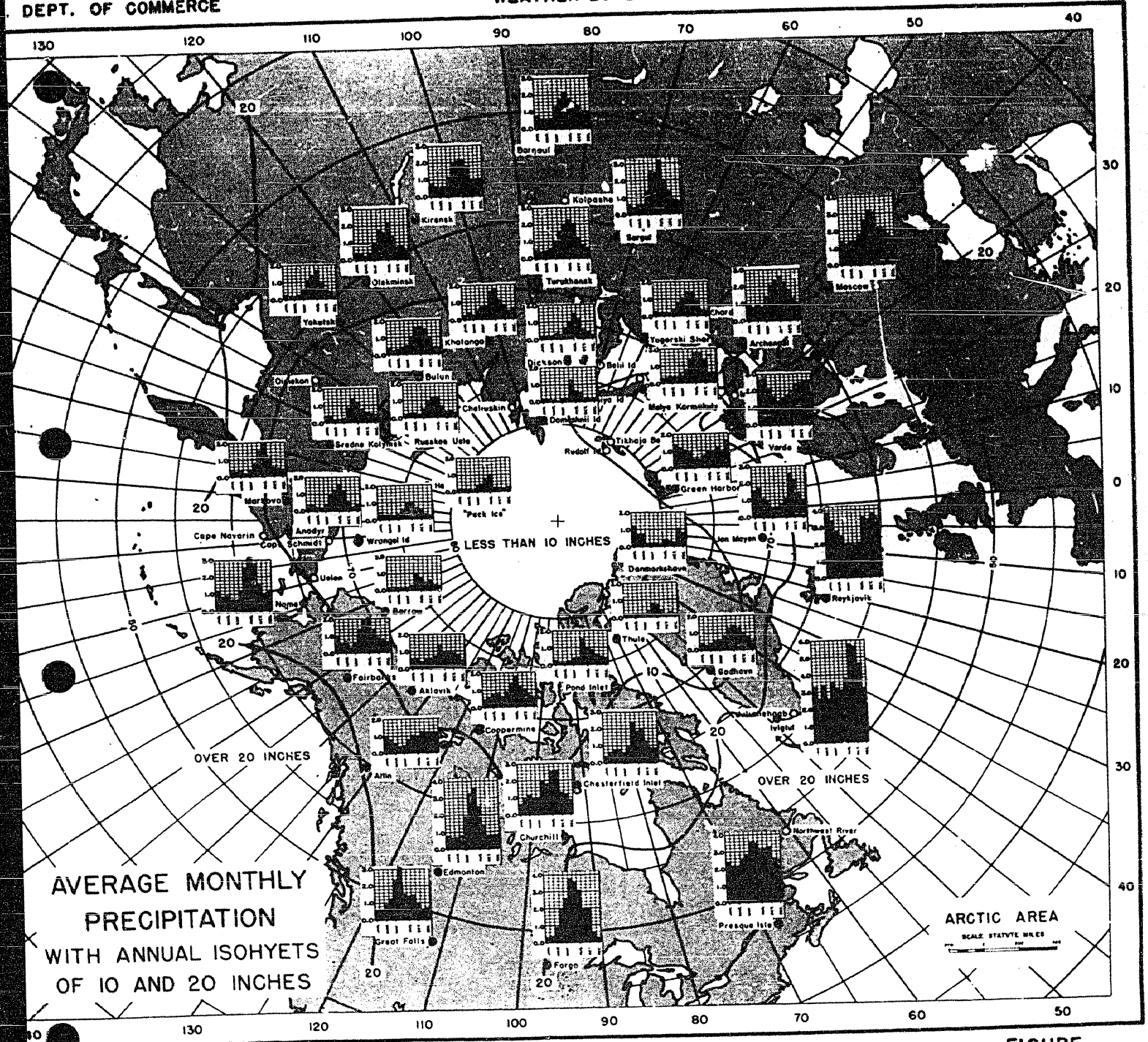

AVERAGE MONTHLY PRECIPITATION WITH ANNUAL ISOHYETS OF 10 AND 20 INCHES

FIGURE

STAT 422407

BASE STAT 422086-2

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SNOWFALL

Snowfall is usually the most unsatisfactory of all meteorological elements to deal with. This is even more true in the more northerly regions. The wind makes it extremely difficult to obtain a representative "catch" in the gage and in many cases it is impossible to decide whether the snow is falling or has been whirled up by the wind. To associate large amounts of snow with the Arctic regions is a common error. On the average the snowfall is very light and extraordinarily heavy snows occur in localities with mountainous terrain in lower latitudes or in the bay regions of the southeastern section of the Canadian Archipelago.

It must be remembered that the permanent snow line is at elevations considerably above the average of the regions under consideration. There are always two to four months in summer when the land is free of snow except possibly some deep gullies or northern slopes. Any unseasonal snows occurring in the warmer months soon disappear. Besides Greenland only a few of the northernmost islands of the Canadian Archipelago have permanent snow fields.

In the treeless portion of the continental regions the average annual snowfall does not exceed 2 feet and the snow is swept clean in some areas and piled high in others. Difficulty in sledging is frequently encountered due to lack of snow even in late winter and early spring when a maximum snow cover would be expected. With low winter temperatures the snow is in the form of minute spicules which form so compact a mass that "a cubic foot of this snow will weigh 30 pounds; that is, 2 inches of this snow may be equivalent to one inch of rain."

All seasons tend to be stormy but the north is not so stormy as one might be led to expect. In the winter the normal storm tracks are far to the south. Wide variations are found from year to year in the average location of storm tracks and as a result there are some winters with numerous storms while others have calm and clear weather predominating. There are times when storm centers cross Hudson Bay and Labrador, usually on their way to southern Greenland. This will bring heavy snow to the southeastern section of the Canadian Archipelago. The average annual snowfall amounts to approximately 5 feet around the margin of Hudson Bay, while the most ever observed in any one month was about 3 feet. Farther north in the Baffin Bay region we find a climate which is greatly affected by marine influence. February is the coldest month with winter conditions lagging into March and early April. Heaviest precipitation is recorded in November and December with the result that snowfall constitutes a large percentage of the total annual precipitation. The mean snowfall is about 5 feet with as much as 6 and 1/2 feet recorded in one December.

In Siberia winter snowfall is heaviest in the taiga or forest belt, where a depth of 3 feet is not uncommon. In the regions farther north the snowfall is considerably less and the wind swirls the snow over the treeless ground, leaving many spots exposed to the severe winter frost. Here the subsoil remains permanently frozen. Lighter falls are also reported in the steppes south of the forest belts, where the strong northeast winds soon sweep away what snow does fall.

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The average thickness of snow cover for selected stations in eastern Siberia is presented in table 75. Although a distinct correlation between the snow cover and the amount of winter precipitation is immediately seen, the thickness of the snow cover is far from being determined by the snow fall alone and depends as well on many other agents, such as air temperature, wind, evaporation, rime formation, etc. Topographical conditions exert a great influence on the accumulation of snow, since larger amounts of precipitation fall on windward slopes with lesser amounts on the lee side. The period of uninterrupted snow cover lasts, on the average, from 250 to 260 days in the extreme northern regions and gradually decreases with latitude. The time of maximum cover is most generally February in the continental regions. However, the majority of the stations in table 75, are located in the northern portions and it is not surprising to find that March and April, on the whole, are the months with the maximum average snow cover, while at Russkoe Uste, which is on the coast, it is even May.

The blizzards of northern United States and Canada are cold waves of a special type, in which there is a howling gale of wind, and the air is full of powdery snow. The chief pressure characteristic of these cold waves is a large area of high pressure moving southward from the Canadian interior and often extending well into the United States. The synoptic picture is usually completed by an intense low passing eastward or northeastward across the central plains of the United States, thus producing a pressure distribution which highly favors an enormous indraft of cold air from the Arctic. The flat plains of Canada and northern United States offer little resistance to the strong northwesterly winds, and velocities exceeding 50 m.p.h. are often attained. The fall in temperature may be considerable, perhaps as much as 70° in 36 hours. The snowfall is usually very light and gradually ceases as the temperature falls. However, the increasing winds sweep the snow up from the ground to such an extent that it appears as a continuous snowstorm. In Asia the wild buran or purga snowstorms are closely akin to the blizzard. The penetrating power of the driving snow in these storms is sometimes unbelievable. It is impossible to remain alive many hours without shelter, and wayfarers lose their way quite easily with serious risk of being frozen to death. Very poor visibilities and strong winds produce surface conditions extremely hazardous to flying.

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Table 71

Mean Monthly and Annual Snowfall (in.): North American Arctic

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Yrs. Rec.
Aklavik	5.8	5.5	3.8	5.9	2.8	6.4	0.0	6.3	5.2	10.0	6.5	5.2	63.4	--
Anchorage	13.5	9.9	7.6	2.7	0.3	0.0	0.0	0.0	T	4.5	10.3	10.8	59.6	19
Barrow	2.4	3.5	2.3	3.2	2.0	0.4	1.2	0.7	3.2	8.6	4.7	4.1	36.3	18
Chesterfield	3.5	6.1	7.2	7.4	4.4	T	0.0	0.0	1.3	10.4	8.5	8.6	57.4	6
Churchill	6.2	9.8	10.8	8.4	2.0	1.2	0.0	0.0	2.7	6.9	11.6	8.6	68.2	18
Coppermine	3.5	5.6	7.3	6.8	3.9	2.9	0.1	0.4	4.7	9.1	8.6	5.3	58.2	--
Craig Harbour	3.8	2.4	5.4	5.1	3.8	5.3	0.0	0.6	5.4	14.1	7.7	2.2	55.8	4
Dawson	8.3	7.8	5.2	3.8	0.7	0.2	0.0	T	1.7	8.0	9.9	9.3	54.9	30
Dutch Harbor	16.5	19.7	11.4	6.6	0.2	0.0	0.0	0.0	0.0	0.3	5.7	12.6	73.0	10
Edmonton	7.0	6.7	6.2	3.6	1.3	T	0.0	T	0.7	3.5	6.7	6.8	42.5	
Etah	1.1	0.6	2.2	3.1	0.7	0.1	---	---	2.9	2.7	5.3	2.5	21.3*	10 mos.
Fairbanks	11.7	7.2	8.1	2.7	0.4	T	0.0	0.1	0.7	6.5	7.4	8.7	53.9	10
Fargo	7.2	6.5	6.9	3.6	0.3	0.0	0.0	0.0	0.1	0.9	5.8	6.9	38.2	50
Fond du Lac	5.3	2.6	2.7	0.9	1.0	0.0	0.0	0.0	0.1	2.7	7.4	5.5	28.2	24
Fort Chipewyan	6.8	5.4	6.5	4.4	1.6	0.1	0.0	0.0	0.1	4.6	8.8	8.0	46.3	45
Fort Good Hope	4.7	5.2	5.9	5.4	4.4	0.5	0.0	0.3	3.9	8.5	7.2	5.2	51.2	21
Fort McPherson	6.8	4.9	4.6	8.0	2.9	0.4	0.0	0.0	3.4	6.9	6.7	7.5	52.1	19
Fort Norman	3.9	4.8	4.3	4.6	3.0	0.1	0.0	0.1	1.9	6.8	3.6	3.7	36.8	21
Ft. Resolution	5.8	6.1	5.6	2.9	1.6	0.5	0.0	0.0	2.3	6.7	13.0	6.3	50.8	15
Fort Simpson	6.2	7.3	4.9	6.5	5.0	T	0.0	0.1	1.8	10.9	7.3	8.6	57.8	--
Great Falls	8.0	6.5	8.2	3.9	0.6	0.0	0.0	0.0	1.0	2.1	6.4	7.4	44.1	50
Hay River	6.2	5.2	4.8	4.3	1.7	T	0.0	0.0	0.8	4.8	7.8	7.6	43.2	36
Juneau	28.1	23.8	14.9	4.6	0.1	0.0	0.0	0.0	0.1	1.5	9.1	25.0	107.2	37
Lake Harbour	7.2	7.1	6.0	10.0	7.1	2.2	T	0.0	1.0	12.3	11.5	4.9	69.3	6
Le Pas	7.4	5.5	11.5	5.1	0.3	0.0	0.0	0.0	0.1	5.8	12.6	13.0	61.3	9
Moose Factory	12.6	9.1	10.3	5.5	3.0	0.4	0.0	0.0	T	2.8	7.7	11.0	62.4	33

T = Trace.

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Table 71 (cont.)

Mean Monthly and Annual Snowfall (in.): North American Arctic (cont.)

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Yrs. Rec.
Nome	10.2	9.2	10.7	4.9	0.9	0.2	0.0	T	0.5	3.6	8.7	11.5	58.4	--
Norway House	6.9	7.3	9.5	4.9	2.6	T	T	0.0	0.9	2.4	10.1	8.0	52.6	--
Pond Inlet	2.5	1.0	0.9	1.7	2.4	0.4	0.0	0.2	1.3	5.6	4.7	3.9	24.6	5
Port Nelson	6.0	4.6	5.8	6.3	3.7	2.1	0.1	0.0	1.6	5.5	10.4	8.1	54.2	15
Resolution Island	10.4	17.0	10.0	10.0	8.9	3.1	0.0	0.1	1.0	17.9	14.4	20.8	33.3	6
St. Paul Island	15.3	11.3	9.7	5.7	2.5	T	0.0	0.0	0.1	1.0	3.8	9.2	58.6	19
Vancouver	12.0	7.9	3.6	0.1	0.0	0.0	0.0	0.0	0.0	0.2	2.5	3.8	30.1	--

T = Trace.

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Table 72

Mean Monthly and Annual Number of Days with Snow: North American Arctic

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Yrs. Rec.
Aklavik	6	7	4	5	4	4	0	2	6	8	7	5	58	
Anchorage	5	6	5	4	*	0	0	0	0	1	7	8	40	4
Barrow	2	1	1	3	3	1	2	3	8	5	5	6	44	5
Chesterfield**	2	2	3	1	2	0	0	0	2	5	3	3	23	6
Churchill**	4	5	5	7	2	*	0	0	1	8	10	7	49	6
Coppermine	3	3	6	4	3	2	1	1	4	4	5	3	40	
Craig Harbour**	5	3	5	4	7	5	0	1	5	5	8	4	56	4
Dawson**	8	6	4	3	1	*	0	*	1	6	5	7	45	10
Dutch Harbor	14	12	12	5	1	*	0	0	*	2	6	10	66	10
Fairbanks	13	9	9	7	3	1	0	0	3	12	13	10	80	10
Fort McPherson	4	4	3	4	3	1	0	1	4	8	3	3	40	
Godthaab	13	12	12	10	8	4	*	*	4	9	11	12	92	
Ivigtut	11	9	10	8	5	1	*	*	2	6	9	10	70	
Jakobshavn	8	7	8	8	7	4	*	*	5	9	10	10	76	
Jan Mayen	15	17	15	11	10	3	1	*	6	9	15	17	116	
Julianehaab	9	9	8	7	4	1	*	*	1	5	7	8	60	
Juneau	17	15	16	8	1	0	0	0	*	3	10	15	85	24
Lake Harbour**	5	5	6	6	8	2	*	0	1	9	9	7	58	6
Le Pas**	6	5	5	3	1	0	0	0	*	3	6	5	34	23
Nome	15	14	15	16	10	1	0	0	2	12	14	16	115	10
Pond Inlet**	3	1	2	2	2	*	0	*	1	5	4	4	24	5
Resolution Island**	9	11	10	12	10	3	0	*	1	9	14	12	91	6
St. Paul Island	18	14	15	16	7	*	0	0	1	8	14	16	109	10
Upernavik	4	4	6	5	6	3	1	1	6	10	10	6	63	
Vancouver	6	4	2	1	0	0	0	0	0	*	1	3	17	
Winter Harbour	14	8	15	9	15	7	0	-	17	24	6	2	--	1

* Less than 1 day.

** Days with 0.1 inch snow or more.

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Table 73

Mean Monthly and Annual Number of Days with Snow: Siberian Arctic

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Yrs. Rec.
Anadyr	10	9	9	8	6	1	1	2	3	6	9	10	74	10
Archangel	8	9	8	4	3	1	0	0	1	6	10	10	60	--
Barnaul	7	5	5	3	1	0	0	0	*	4	8	8	41	54
Bear Island	11	12	13	8	8	2	*	*	3	8	12	10	87	--
Cape Cheliuskin	8	13	3	3	4	11	1	4	15	9	12	10	93	1
Dickson Island	8	9	10	10	10	8	4	4	9	14	13	8	107	--
Domashnii Island	8	7	7	4	5	6	5	7	7	10	6	6	78	4
Dudinka	6	6	7	8	4	2	0	0	4	12	11	9	69	3
"Fram"	11	11	13	13	15	17	14	14	13	14	9	9	156	2
Lyakhovski Island	8	7	4	3	4	4	4	3	8	14	9	7	75	7
Green Harbor	11	12	12	9	6	4	1	*	5	9	10	11	90	--
Kem	8	6	8	6	4	1	0	0	1	6	8	8	56	29
Kirensk	16	15	15	9	4	0	0	0	2	14	15	17	111	10
Kola	6	5	7	5	4	2	*	1	1	6	7	6	50	14
Malyo Karmakuly	16	14	13	12	12	7	1	1	5	12	14	14	121	14
Markovo	8	7	8	5	4	1	0	*	3	10	10	10	66	10
"Maud"	2	8	6	6	15	13	7	12	15	13	6	6	113	2
Moscow	18	15	13	6	1	*	0	0	1	5	14	18	91	18
Nizhne Kolymsk	8	9	8	8	6	1	1	4	10	13	10	10	88	5
Obdorsk	5	6	6	6	10	2	*	*	3	8	8	7	60	10
Olekminsk	6	5	4	7	4	0	0	0	2	9	10	8	55	10
Rodchevo	16	16	10	5	4	1	0	2	5	12	15	20	110	4
Russkoe Ustie	4	4	4	2	9	6	2	4	11	7	8	6	67	4
Sagastyr Island	4	5	1	2	8	4	0	2	7	4	10	6	53	2
Srednе Kolymsk	3	5	4	3	1	1	*	1	4	8	8	4	26	5
Surgut	11	8	8	8	7	*	0	0	2	10	10	17	84	8
Tiksi Bay	4	9	7	5	4	2	1	0	8	11	5	5	61	3

* Less than 1 day.

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Table 73 (cont.)

Mean Monthly and Annual Number of Days with Snow: Siberian Arctic (cont.)

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Yrs. Rec.
Turukhansk	10	9	10	9	9	4	*	*	7	16	15	14	103	15
Uolen	7	6	8	8	5	1	1	1	5	10	11	9	72	8
Vaigach	13	11	10	10	8	4	1	0	4	12	12	13	98	18
Vardo	16	17	16	12	1	0	4	0	*	3	11	17	121	20
Verkhoyansk	2	1	1	1	1	1	0	1	1	3	1	4	17	6
Wrangel Island	8	7	7	6	8	4	1	5	8	8	7	7	76	9
Yakutsk	9	6	4	4	1	0	0	0	1	10	9	9	53	14
Yugorski Strait	13	10	11	9	10	5	1	1	6	15	15	14	107	

* Less than 1 day.

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Table 74

Average Depth (in.) of Snow on the Ground: Alaska and Canada

Stations	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Yrs. Rec.
Alaska												
Barrow												
End of Month	0.3	0.8	3.4	5.2	6.3	7.5	6.9	8.1	6.0	2.7	T	8
Fairbanks												
15th of Month	0.0	0.0	0.6	6.9	13.1	19.6	25.9	20.2	7.2	1.2	0.0	11
End of Month	0.0	T	3.7	9.8	14.7	24.7	25.1	16.3	3.2	0.0	0.0	11
Nome												
15th of Month	0.0	0.0	0.3	1.3	3.8	9.0	12.9	14.0	12.1	7.1	0.0	11
End of Month	0.0	T	0.4	2.2	7.1	16.0	14.4	18.1	10.2	0.4	0.0	11
Canada (depth at end of month)												
Atlin	0.0	0.0	0.8	4.2	7.3	7.9	13.1	10.9	2.2	0.0	0.0	10
Dawson	0.0	0.0	1.4	8.6	12.5	22.6	25.0	3.9	0.0	0.0	0.0	10
Ft. George	0.0	0.0	4.7	18.6	32.0	41.0	46.5	37.1	16.4	0.0	0.0	4
Ft. McMurray	---	---	---	2.2	10.7	14.6	19.1	11.2	0.0	0.0	0.0	1-2
Ft. Nelson	---	---	---	3.8	5.2	10.4	12.2	6.3	0.0	0.0	0.0	1-2
Ft. Vermilion	0.0	0.0	3.3	12.9	15.1	20.0	18.6	16.8	0.0	0.0	0.0	10
Hudson Hope	0.0	0.0	1.7	1.8	6.6	10.0	3.8	3.8	0.1	0.0	0.0	10
Le Pas	0.0	0.0	7.0	13.3	16.0	18.3	22.5	4.7	0.0	0.0	0.0	5
Mayo Landing	0.0	0.0	1.9	7.2	10.2	16.6	19.4	14.2	0.2	0.0	0.0	10
Pangnirtung	0.0	2.0	17.5	25.0	29.7	34.0	39.7	42.0	52.0	15.0	0.0	3
Port Harrison	---	---	---	13.5	---	15.0	18.0	25.0	---	---	---	1
Winnipeg	0.0	0.0	0.4	3.5	6.8	16.4	10.9	7.0	0.0	0.0	0.0	8

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Table 75

Average Thickness (in.) of Snow Cover in Siberia

Stations	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Anadyr	0.1	1.7	4.6	8.5	12.8	17.6	20.3	21.5	17.7	1.8
Blagoveschenski	T	1.9	10.1	15.8	20.6	23.5	25.2	21.4	2.0	0.0
Bulun	0.7	3.2	3.5	3.6	4.2	5.0	4.0	8.3	6.2	0.0
Cape Schmidt	0.0	3.1	4.3	3.9	3.9	5.9	7.9	9.8	5.9	0.2
Dudinka	0.0	5.2	24.7	35.7	44.0	50.1	58.0	6.3	---	---
Irkutsk	0.0	0.6	2.4	5.4	7.0	8.4	7.2	0.7	T	0.0
Kironsk	0.0	0.9	5.4	10.2	14.1	16.8	16.9	7.2	T	0.0
Krasnoyarsk	0.0	0.3	2.0	5.2	6.6	7.5	5.0	0.2	T	0.0
Markovo	0.2	2.8	12.2	23.0	29.4	38.3	43.3	45.3	35.0	2.1
Nizhne Kolymsk	T	3.2	9.4	11.7	13.0	17.4	18.5	18.9	12.3	0.1
Okhotsk	0.0	0.8	3.7	7.6	9.8	11.2	11.1	13.0	7.4	0.0
Olekminsk	0.2	1.3	6.5	9.0	10.9	13.4	12.2	5.7	0.0	0.0
Rodchevo	0.1	2.2	7.4	11.7	14.8	17.1	19.3	18.7	6.7	0.0
Russkoe Uste	0.8	5.6	9.7	14.5	18.2	21.2	22.6	23.5	23.9	3.1
Srednie Kolymsk	T	4.3	8.8	12.9	14.8	17.5	18.5	16.3	7.7	0.0
Turukhansk	0.1	3.4	14.3	23.3	34.3	38.6	40.9	42.9	28.4	1.9
Verkhoyansk	0.4	2.5	5.6	7.5	8.6	9.9	10.6	10.4	3.5	T
Yakutsk	T	0.7	4.1	6.3	10.3	13.3	14.6	8.3	0.0	0.0
Vaigach										
10th	0.0	0.0	2.0	6.7	8.3	10.6	12.6	11.4	11.8	7.1
20th	0.0	0.8	3.5	8.3	10.6	11.0	12.6	12.2	11.4	2.4
End of Month	0.0	2.0	3.9	8.7	10.6	11.8	12.2	12.6	10.6	0.0

T Trace; greatest thickness is underscored.

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Table 76

Duration of Snow Cover in Siberia
(3 to 4 Years Record)

Station	Dates of formation			Dates of disappearance			Number of days with snow cover
	Mean	Earliest	Latest	Mean	Earliest	Latest	
Vaigach	10/17	9/29	11/20	6/22	6/15	6/30	249
Yugorski Strait	10/14	9/22	11/21	6/14	5/25	6/27	242
Lyakhovski Island	10/1	9/28	10/3	6/6	6/3	6/9	249

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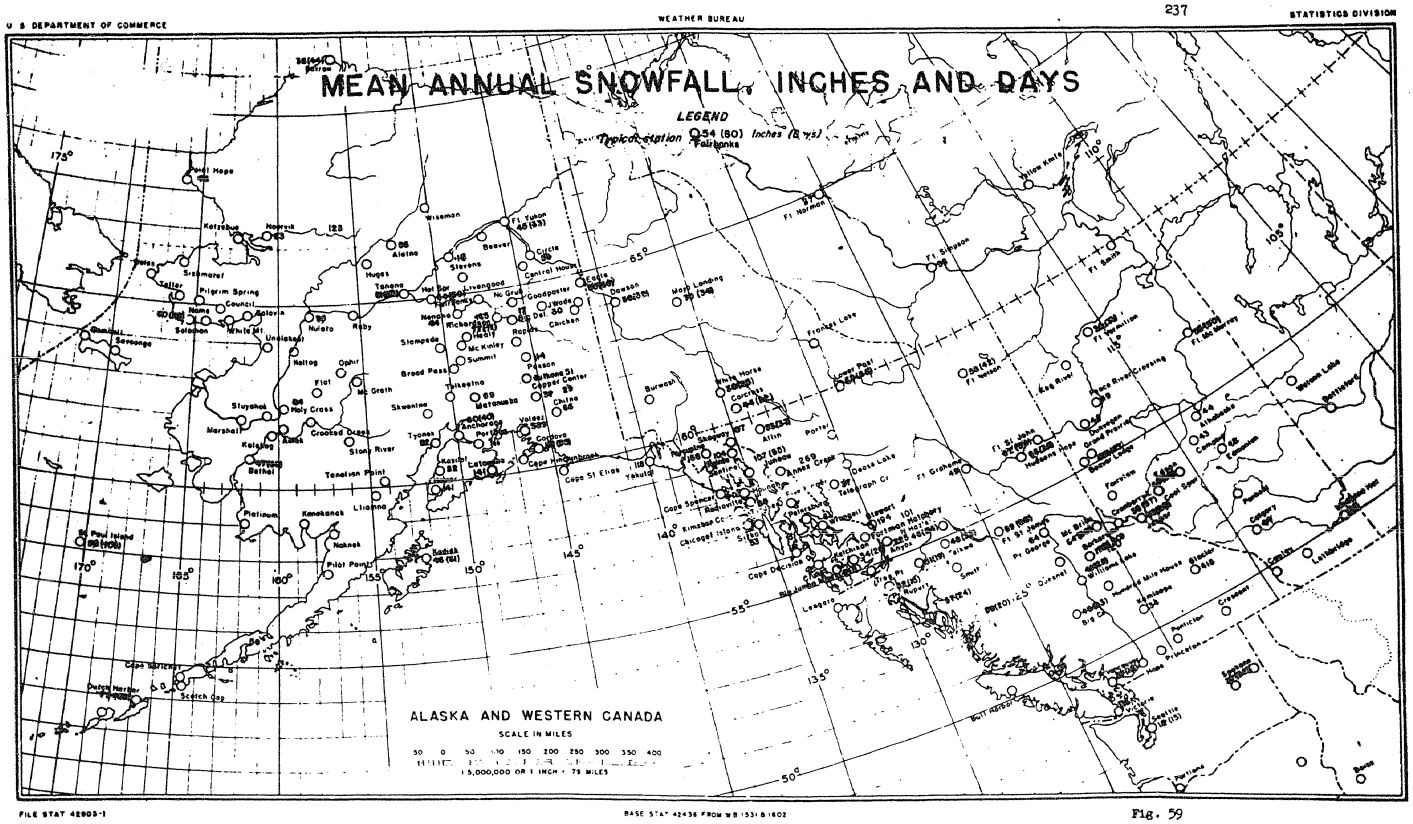
MEAN ANNUAL SNOWFALL, INCHES AND DAYS
LEGEND
Tropical station
234 (80) Inches (& yrs.)
Fairbanks
ALASKA AND WESTERN CANADA
SCALE IN MILES
50 0 50 100 150 200 250 300 350 400
1:5,000,000 OR 1 INCH = 79 MILES

FILE STAT 42903-1 — BASE STAT 42436 FROM WB 1531 & 1602

Fig. 59

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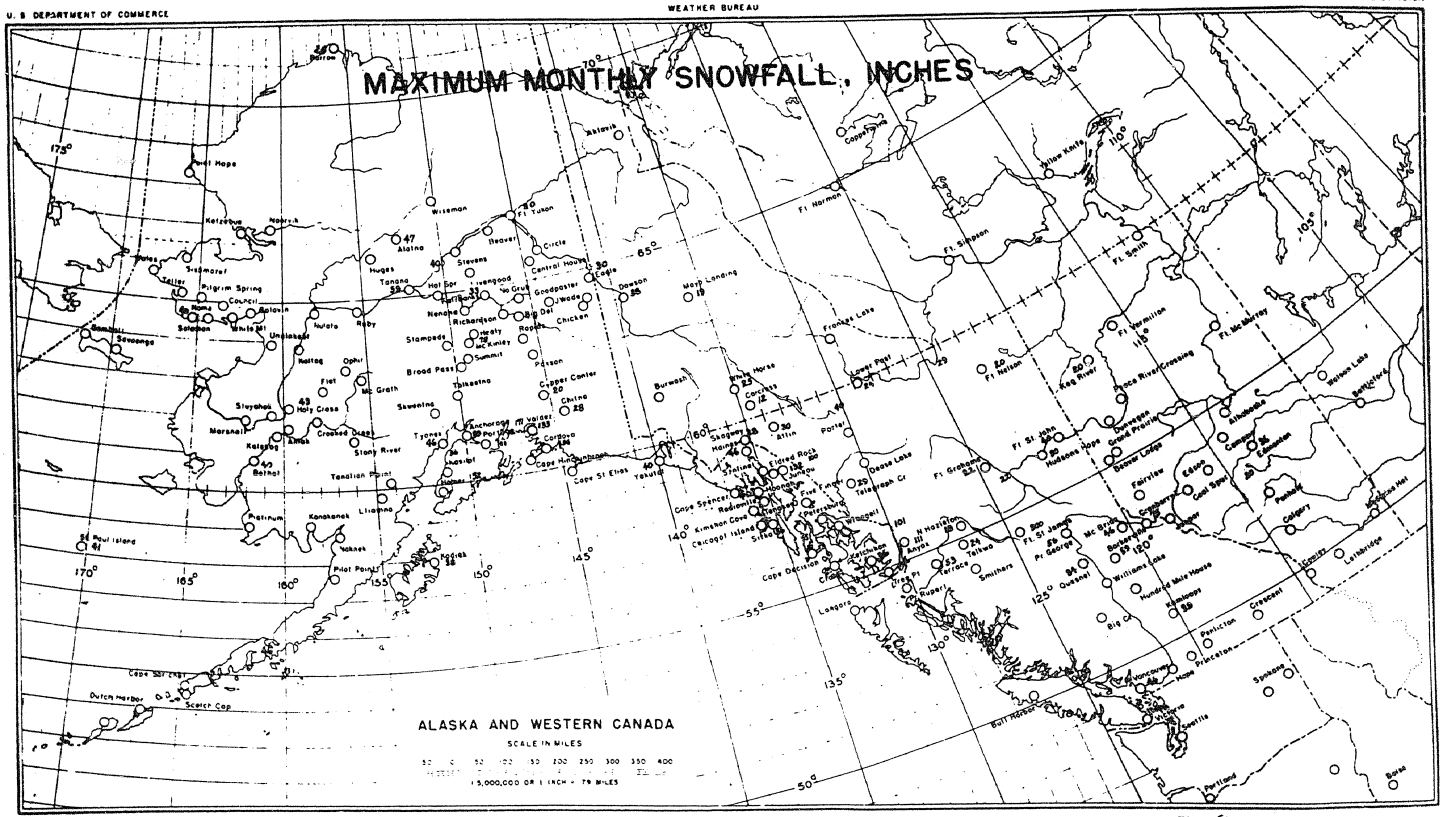

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Fig. 60

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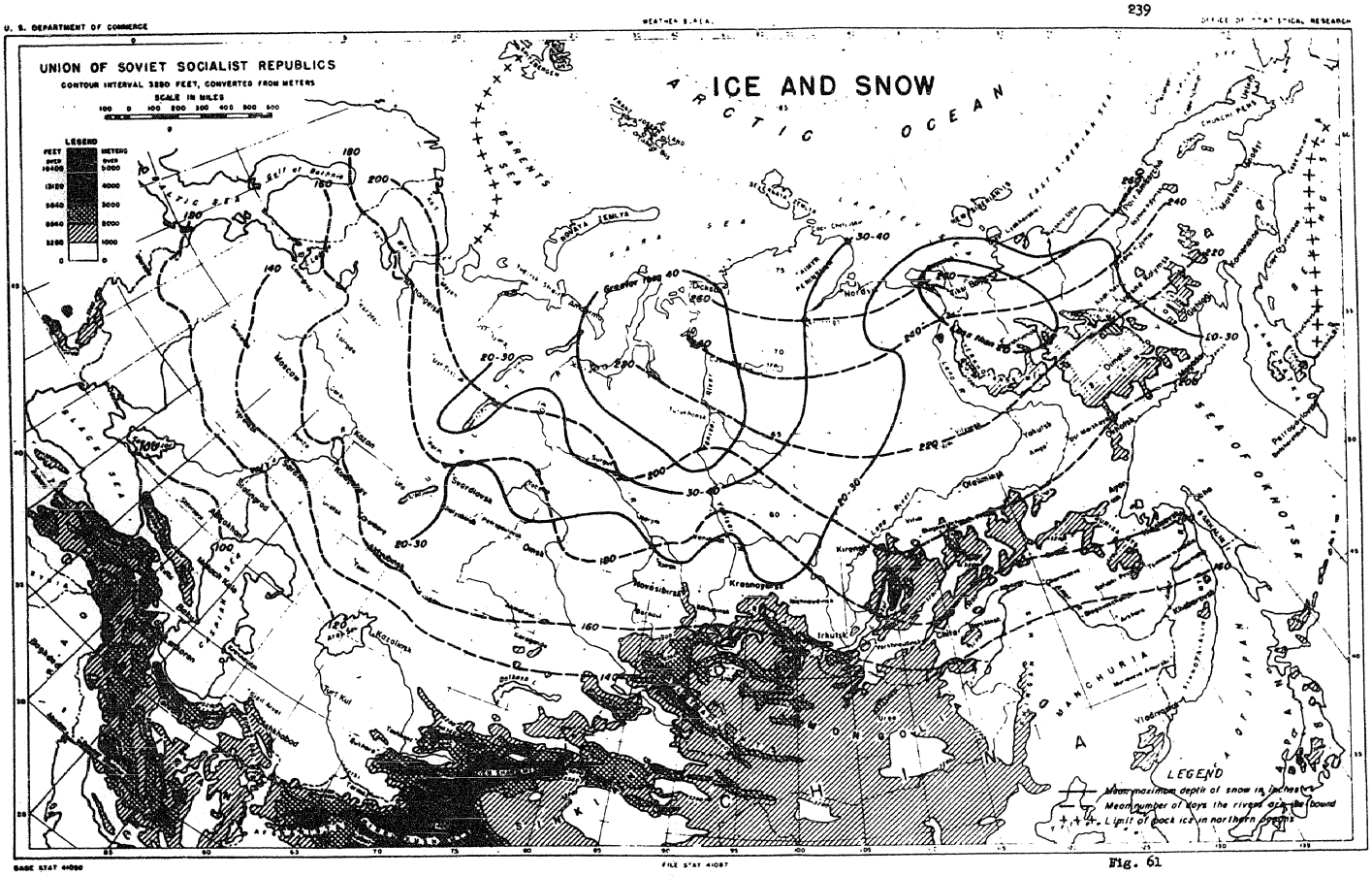

Fig. 61

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SEA ICE

The distribution of ice in the Arctic regions has an important bearing on the practicability of flights across the Arctic. Large floes afford suitable landing fields in case of emergency, but such emergency landings are hazardous because of the presence of hummocks or pressure ridges and of cracks or leads. There is also the possibility of locating semipermanent stations on the polar ice for the transmission of weather reports and radio signals. Such stations, if located in the "zone of inaccessibility", would drift but very slowly and probably would not have to be moved more often than once each season.

The following description is taken in part from the writings of Dr. Rudmose Brown. "The sea water begins to freeze at a temperature of about 29° F. The first sign is an oily or opaque appearance of the water, due to the formation of ice spicules which rapidly increase in number until the sea is covered with a layer of plastic ice, known as young ice. As the young ice forms it tends to divide into hexagonal plates, three or four inches to a foot or more in diameter. These plates, rolled against one another by the slightest movement, have their edges rounded and turned up, the cakes of ice thus formed being known as pancake ice. The pancakes freeze together, become loaded with snow and form floes. Moving floes form the pack ice which drifts with the wind and current. The actual level of the ice is often below the water level owing to the weight of the accumulated snow. In the pack, the true ice, as distinguished from the snow surface, is rarely visible after the first few days of growth.

Sea ice may grow in thickness as much as four or five inches in forty-eight hours. The ice which has grown in thickness during a winter may have attained a thickness of five to seven feet by summer, but its growth does not always stop."

During the summer the surface snow, the protruding edges of rafted ice and even the topmost layers of the sea ice melt. Large pools of water form in heavily hummocked areas. But while this surface melting takes place, new ice is being added to the under side of the floes, so that the thickness of the ice at the close of summer will be nearly equal to that at the beginning of the warm season. In the process, however, much of the salt is lost from the surface ice, and this old ice can be melted and used for drinking water. Ice formed in this way may increase up to 12 feet in thickness, but thicknesses of from five to seven feet appear to be more common.

"Sea ice, except in very sheltered bays, is liable at all times to break up and drift under the influence of wind and tide and sea currents." The drift of the ice is generally between 30° and 40° to the right of the wind, or parallel to the isobars. In the Greenland Sea, the ice is carried along by the stronger sea currents.

Rafting occurs when large moving floes are driven together or the floes are driven upon coastal fast ice. The longer the pressure lasts the greater the chaos produced. Ice several years old nearly always shows signs of pressure in the occurrence of hummocks twenty to fifty feet in height. When the pressure is released, cracks are formed between the floes. The sequence of pressure and release may take place at any time of year and under all temperature conditions found in the

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Arctic. The area to the north of Greenland and north of the Canadian Archipelago appears to be particularly susceptible to the formation of very rough hummocked ice. The least rafting occurs where the wind and ice movement are the least, near the center of the Arctic Anticyclone.

The average extent of the polar ice is shown in figure 62. The central area is made up of old polar ice and encloses the area known as the zone of inaccessibility. Movement of the ice is the least within this area, and for that reason it affords the most favorable location for semipermanent weather or radio stations. Toward the Canadian Archipelago the ice at the edges of this zone is heavily rafted and extremely rough. The larger area covering most of the Arctic region is occupied permanently by the moving Arctic pack. Rafting and the formation of leads takes place constantly within this area, and in the summer there is a considerable increase in the water area. The drift is appreciable in this area, amounting to two to four miles daily near the Pole and six or more miles daily through Denmark Strait. The dotted lines give the average summer limits of the Arctic pack and the dashed lines the winter limits. Fast ice forms along the Siberian and North American coast lines, and reaches its greatest extent over the shallow waters of the east Siberian and Laptev Seas. Beyond the fast ice are large areas of open water, particularly in the Laptev and east Siberian Sea areas, known as "polynias". Seaborne traffic now travels along the "polynias," rather than close to the coasts.

The landing of airplanes on ice will always be more or less hazardous due to the changing nature of the ice fields. Where emergency landings are necessary, the area chosen for landing should be examined closely before the actual landing is made. Skis are preferable to wheels for landing. Should landing fields be established in the vicinity of semipermanent stations on the ice, then the field should be examined before the arrival of airplanes to ascertain if any new cracks or leads have developed in the neighborhood. Similarly the runways should be examined before all take-offs, particularly if several hours have elapsed since the runway was last used.

Definitions (with Russian terms in parentheses)

Black ice--Thin, dark-appearing ice, without snow.
Brash or sludge ice (Shuga)--Small pieces of ice, the wreckage of pack ice, navigable.
Calving (Shchenki)- Used to denote any breakage of ice from glaciers or icebergs; more specifically the breaking of pieces from the bottom of bergs and their coming to the surface.
Debacle--The break-up of the ice in the rivers in the spring.
Drift ice (redkii led)--All ice which is not fast ice; The three groups are (a) extensive fields of polar ice (Arctic pack), (b) broken fields of polar ice (pack ice), and (c) winter drift ice.
Field ice (ledianoe pole)--Largest area of drift ice, at least several miles wide, the limits of which cannot be seen from a ship's mast-head.
Floe (oblomki polei)--An area of drift ice from 1/3 mile in diameter to the size of an ice field.
Floeberg (nasiak)--A detached massive hummock, which may rise to 30 feet above the sea surface.

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Fast ice (beregovoi pripai), also known as land floe--An area of ice extending from the coast, which has remained in position since formation.
Growler (tarytysh)--Detached piece of berg or pack ice, almost awash.
Hummock (Toros)--A ridge or elevation on a floe due to pressure.
(Stamukha); a grounded hummock or floeberg.
Iceberg (ledianaia gora)--Ice detached from a glacier.
Ice blink (Ledianoi otblesk)--A white reflection in the sky indicating the presence of ice. Dark lines in the ice blink indicate the location of leads.
Ice foot (Podoshva lda)--A shelf of ice attached to the coast, unmoved by the tides.
Land floe (Pripai)--An area of ice extending from the coast, which has remained in position since formation. Also known as "fast ice"
Lead (Rasshchelina), also known as land--A navigable channel between floes.
Open water (Otkrytaia voda)--Free navigable water in an ice-encumbered channel or sea.
Pack ice (Pak)--Any sea ice which has drifted from its original position under the influence of wind and currents. "Open" pack ice shows leads; "close" pack ice is without leads.
Pancake ice (Blinchatyi led)--Small cakes of new ice approximately circular and usually with raised rims.
Polar ice (Poliarnyi led)--Ice more than 1 year old; it contains little salt and therefore is hard.
Polynias--A term given to enclosed areas of water other than cracks or leads. A more or less permanent polynias exists between longitudes 130° E and 180° beyond the coastal fast ice. Other polynias have been encountered between the coastal fast ice of North America and the Arctic pack.
Pressure ridge--A ridge or wall of ice caused by rafting.
Rafting (Nabivnoi led)--When two floes come together with considerable force, the edges are broken off and one edge passes over the other.
Water sky--Dark patches or streaks on the clouds due to reflection of polynias or of the open sea in the vicinity of large areas of ice.
Winter ice--Ice of the current season and therefore less than 1 year old. Newly formed stretches of level ice more than 2 inches and less than 8 inches thickness is known as "young ice." Winter ice contains considerable salt and is relatively soft.
Young ice (Zalivnyi led), also known as bay ice--Newly formed ice, or sufficient thickness to impede or prevent navigation.

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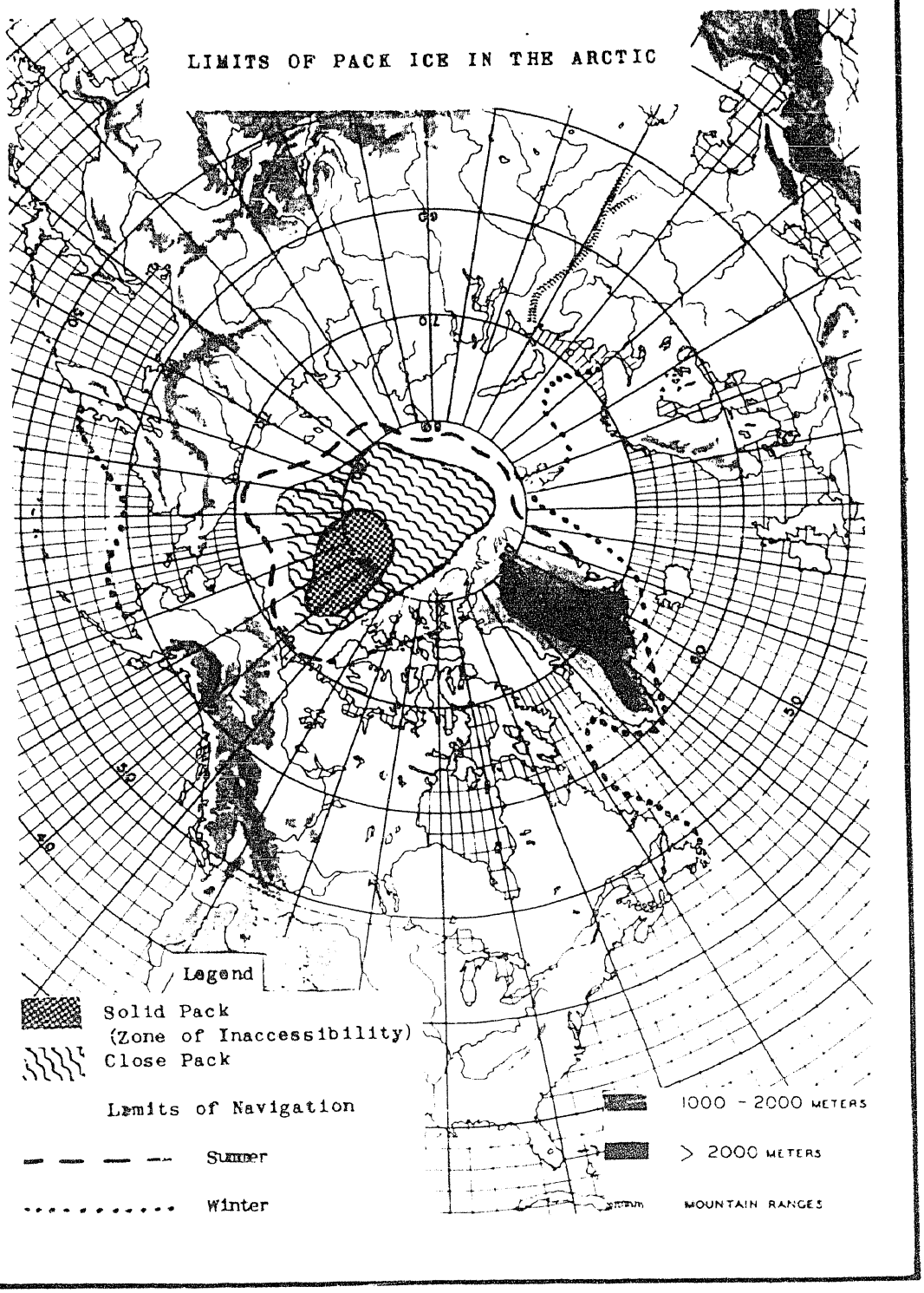

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TABLE

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LANDING OF AIRPLANES ON ICE

In recent years Russian aviators have successfully landed heavily loaded airplanes on the ice in the Arctic Ocean. The most spectacular feat was the landing of the Papanin Expedition with all supplies and equipment near the North Pole. The accumulated experience of the Russian aviators is summarized in an article entitled, "On the Landing of Airplanes upon Ice" by K. A. Moskatov which appeared in the Transactions of the Arctic Institute for 1938. The material for this discussion is drawn largely from this article.

The first successful landing upon ice in the Arctic seas was made in connection with the "Maud" expedition, when a Curtis airplane was landed near the ice-bound "Maud" between Wrangel Island and the Siberian coast in June 1925. Others followed, with heavy airplanes generally being used by the Russians in 1937. In that year, the ice between Rudolph Island and the Pole was surveyed to determine the possibility of landing. The findings apply only to the area surveyed but may be given here to show the types of sea ice encountered.

From 81°45' N. to 82°30' N. floes less than 1,000 feet in diameter, with hummocks up to 3 feet in height, were formed. Landings were not possible here.

From 82°30' N., there were smooth floes approximately 1,000 feet in diameter with numerous hummocks. Thickness of ice varied between three and four feet and the ice was covered with 16 inches of snow. Landings were possible only with experienced pilots.

The strip from 85°30' N. to 86°45' N. marked the limits of the permanent close pack ice. The area had numerous young ice fields and landing was considered impracticable.

The largest ice fields were encountered from 87° to 88°30' N. These frequently reached six to twelve miles in diameter. From 87°30' N. to the Pole smaller fields were encountered. There were elongated floes with platforms 1,000 to 1,600 feet, but with many rounded hummocks covered with hard snow. The ice was not salty; this fact indicated that it was old ice from six to ten feet thick.

The zone of the solid ice-pack constitutes an area where landings can be made throughout the year. (See figure 62.) The old ice is not salty, is much stronger than newly formed ice, and is of a thickness sufficient to support heavy cargo planes. The presence of numerous hummocks necessitates the use of extreme caution in selecting a landing field.

In the area covered by the close Arctic pack (figure 62), landings may definitely be made in winter and probably may be made in the summer. This is the area described by Moskatov in the preceding paragraph. Beyond the edges of the close pack, landings are entirely impracticable in the summer, but may be made with caution in the late winter and spring.

When it is known that landings are to be made on the ice, it is essential to include in the equipment materials for the clearing of the runways for the take-offs. The importance of this equipment may be seen

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from the known fact that where a landing has been made upon the ice in no case has it been possible to take-off without first preparing the surface of the runway. Sometimes the landing-strip is flooded and then allowed to freeze over to give a smoother field.

Conditions to be avoided if possible are: (1) hummocks, leads, polynias, or other obstructions or breaks in the ice; (2) slush, sludge ice, and new ice of insufficient thickness; (3) ice that has been thinned or its structure weakened by thawing; and (4) water flowing over the surface of the ice.

Experiments were first carried on by rolling freight cars over river ice to determine the thickness of ice necessary to support given weights. It was found that a thickness of 8 inches would support a weight of 15 tons. An area of ice within a radius of 100 feet is affected by the load and helps to take up the stress. A car loaded to 24 tons required an ice thickness of 12 inches. When the ice reached a thickness of 49 inches it was found that a steam locomotive could be used. The data on thickness of ice necessary to support various types of airplanes of certain weights are set forth in the following table:

Table 77

Thickness of Ice to Support Certain Weights of Airplanes

Type of Plane (U. S. S. R.)	Operational Weight (lbs.)	Ski Size (ft.) Length	Ski Size (in.) Width	Required thickness of river ice (in.)
"U-2"	2,315	7.2	13.1	3.9 to 4.3
"SH-2"	2,385	4.6	14.2	3.9 to 4.3
"Steel-2"	4,190	7.2	16.9	5.5 to 5.9
"P-5"	7,385	5.9	18.9	7.1 to 7.5
"V-33"	5,950	---	----	6.3 to 6.7
"MP-1"	9,920	---	----	8.3 to 8.7
"MP-1"	9,040	---	----	7.9 to 8.3
"P-6"	13,670	10.2	29.9	9.4 to 9.8
"G-1"	15,430	12.1	35.4	10.2 to 10.6
"G-2"	48,500	18.1	57.5	17.7 to 18.1

The preceding data have been plotted and curves drawn as shown in figure 63. It may be resolved into the formula $S_r = \frac{15}{4}\sqrt{W_t}$, where S_r is the thickness of ice in inches, W_t is the operational weight of the airplane in tons. The conditions apply to river ice frozen under uniform conditions with temperatures lower than 16° F. Ice formed at higher temperatures will require a thickness approximately 25% greater to support the same weight. Ice formed in fresh water lakes appears to be structurally stronger, and will require thicknesses approximately 10% less than river ice; or as shown on the curves may be determined by the formula $S_l = \frac{27}{8}\sqrt{W_t}$. Ice formed from salt water shows great differences in structural strength. Old ice, from which some of the salt has been washed and which has been strengthened by the freezing of relatively fresh water (the type of ice expected in the close pack ice), will require thicknesses nearly twice that of river ice to support the same weight, or as shown in the diagram: $S_s = \frac{27}{4}\sqrt{W_t}$. Again, the conditions and locality of the freezing are very important. Fast ice near the mouths of large rivers is structurally stronger because of the smaller quantities of salt. Ice that is honeycombed by thawing processes in the early summer

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months is very weak. Ice that is frozen rapidly at low temperatures is more saline. Therefore, it follows that ice formed in the Barents and Kara Seas would probably be weaker than ice formed in the east Siberian Sea because of the relatively higher temperatures in the former areas.

MISCELLANEOUS CONDITIONS

Ground conditions are generally good over the Arctic regions during the colder months of the year. The soil is frozen and the lower elevations covered with snow. The higher elevations are windswept and usually have but little snow on the ground. In summer the ground conditions are generally poor. The surface soil thaws under the long hours of sunshine but the subsoil remains frozen. Drainage is poor along the low elevations of the Arctic coast and in the river valleys of the Arctic region. The result is a swampy condition that is unfavorable for all types of ground operations. At all principal towns in the Arctic, however, small fields have been set aside where the natural drainage is good or where artificial drainage has been provided. These fields provide the airports of the Arctic region and their facilities could be expanded to provide for much heavier traffic.

Largely because of the poor ground conditions, the rivers have been developed as the main highways of the Arctic regions. Towns are located near the mouths of the principal rivers and near the main junction points of the rivers inland. Traffic along the rivers is carried by boats in the summer and by dog sled in winter. In the late spring and early summer, during the period of break-up of ice and early summer floods, the rivers are unnavigable. The towns along the coast are open to seaborne traffic only during August and September. During exceptional years, the season may be extended to mid-October. In severe ice years some of the Arctic ports may not be open at all. The Soviets have materially extended the navigation period along the Siberian coast by maintaining a continuous survey of ice conditions and by constructing larger and heavier icebreakers to force passage through the ice.

Vegetation over the Arctic regions is largely confined to mosses, lichens, grasses, and low-growing shrubs. The permanently frozen subsoil precludes the possibility of any extensive tree growth. All lumber for construction purposes must therefore be shipped into the Arctic. Extensive lumbering is carried on near the upper sections of the principal Arctic rivers, and may be rafted down the rivers during the navigation season.

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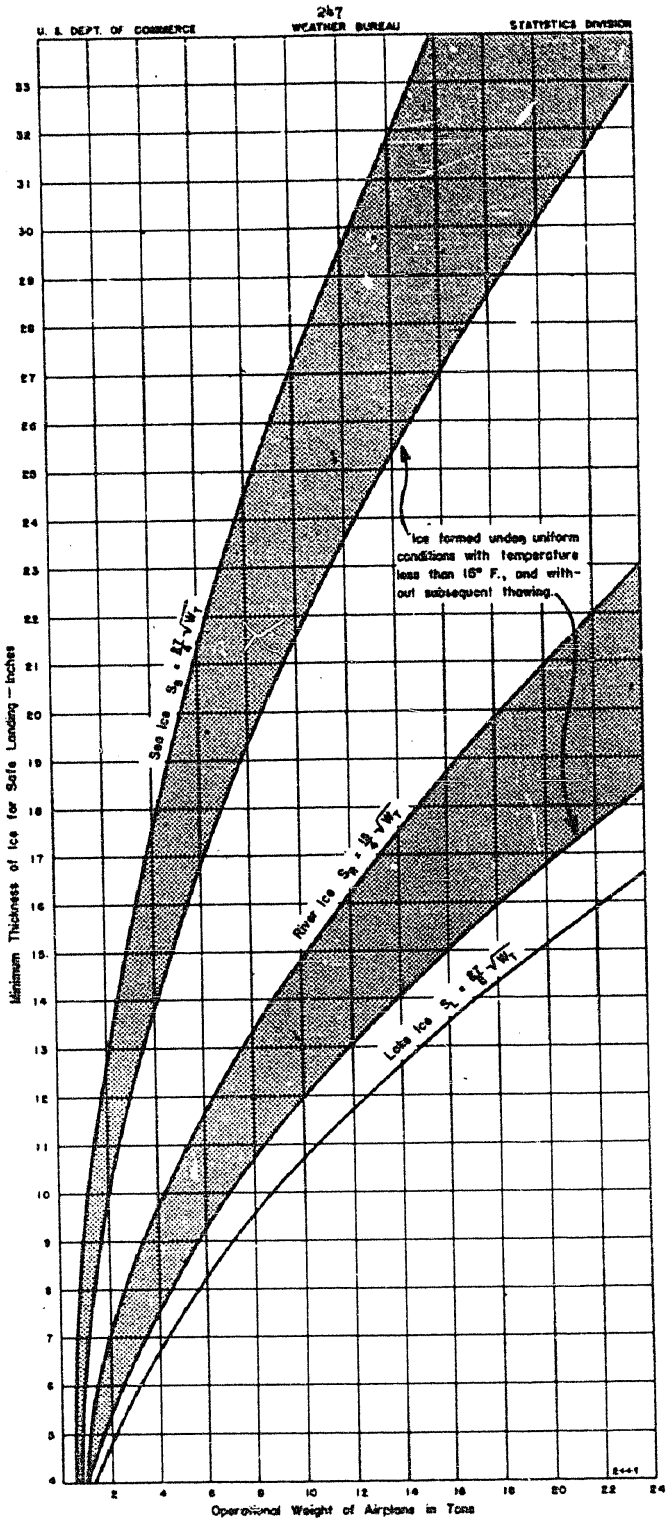
U. S. DEPT. OF COMMERCE
WEATHER BUREAU
STATISTICS DIVISION
Minimum Thickness of Ice for Safe Landing – Inches
Operational Weight of Airplane in Tons
Sea Ice $S_s = \frac{4}{7}\sqrt{W_t}$
River Ice $S_r = \frac{5}{7}\sqrt{W_t}$
Lake Ice $S_l = \frac{6}{7}\sqrt{W_t}$
Ice formed under uniform conditions with temperature less than 15° F., and without subsequent thawing.
2-44-1

MINIMUM THICKNESS OF ICE REQUIRED FOR SAFE LANDING OF AIRPLANES WITH SKIS

Fig. 63

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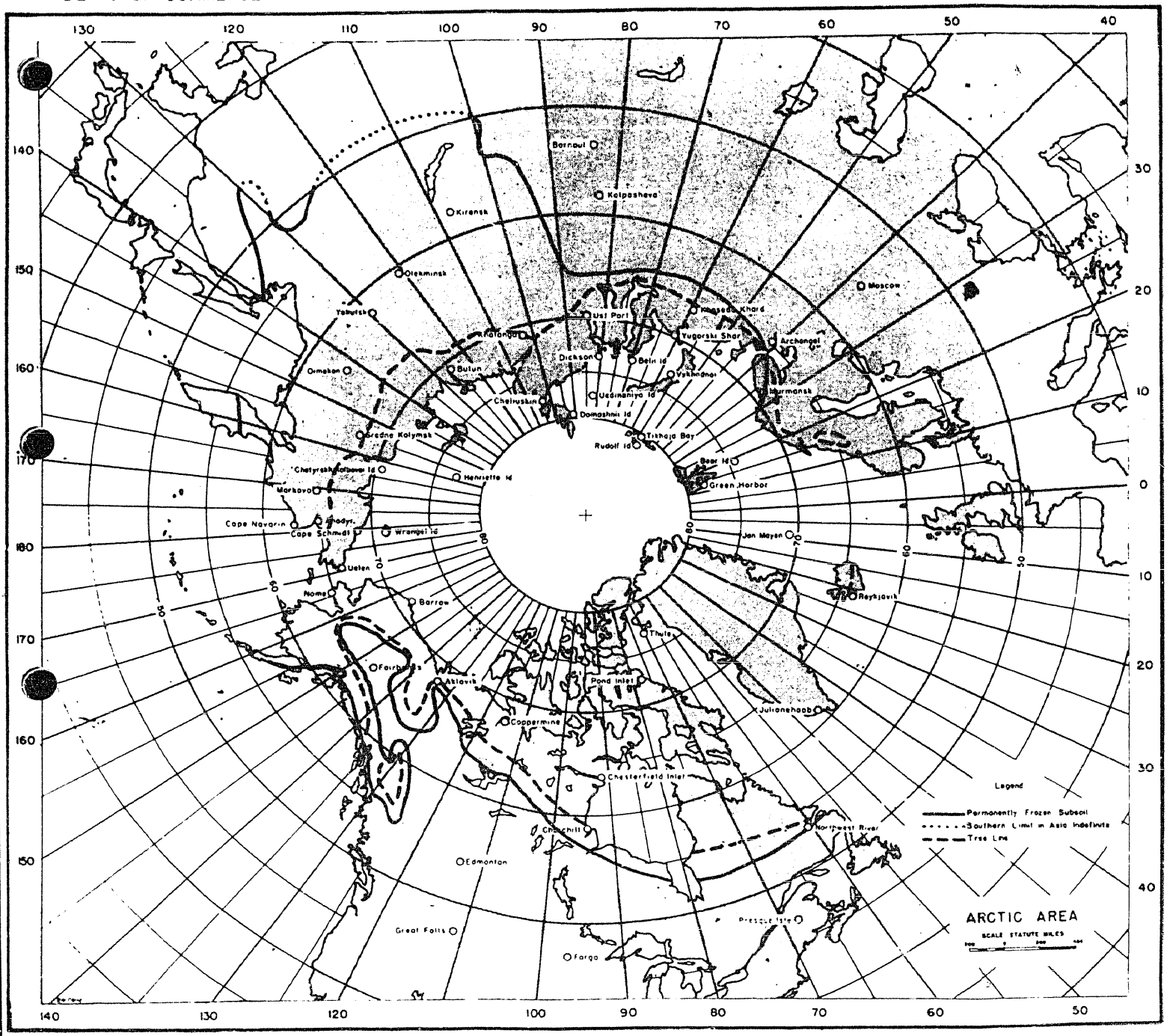

APPROXIMATE SOUTHERN LIMIT OF PERMANENTLY FROZEN SUBSOIL AND NORTHERN LIMIT OF TREE GROWTH

Fig. 64

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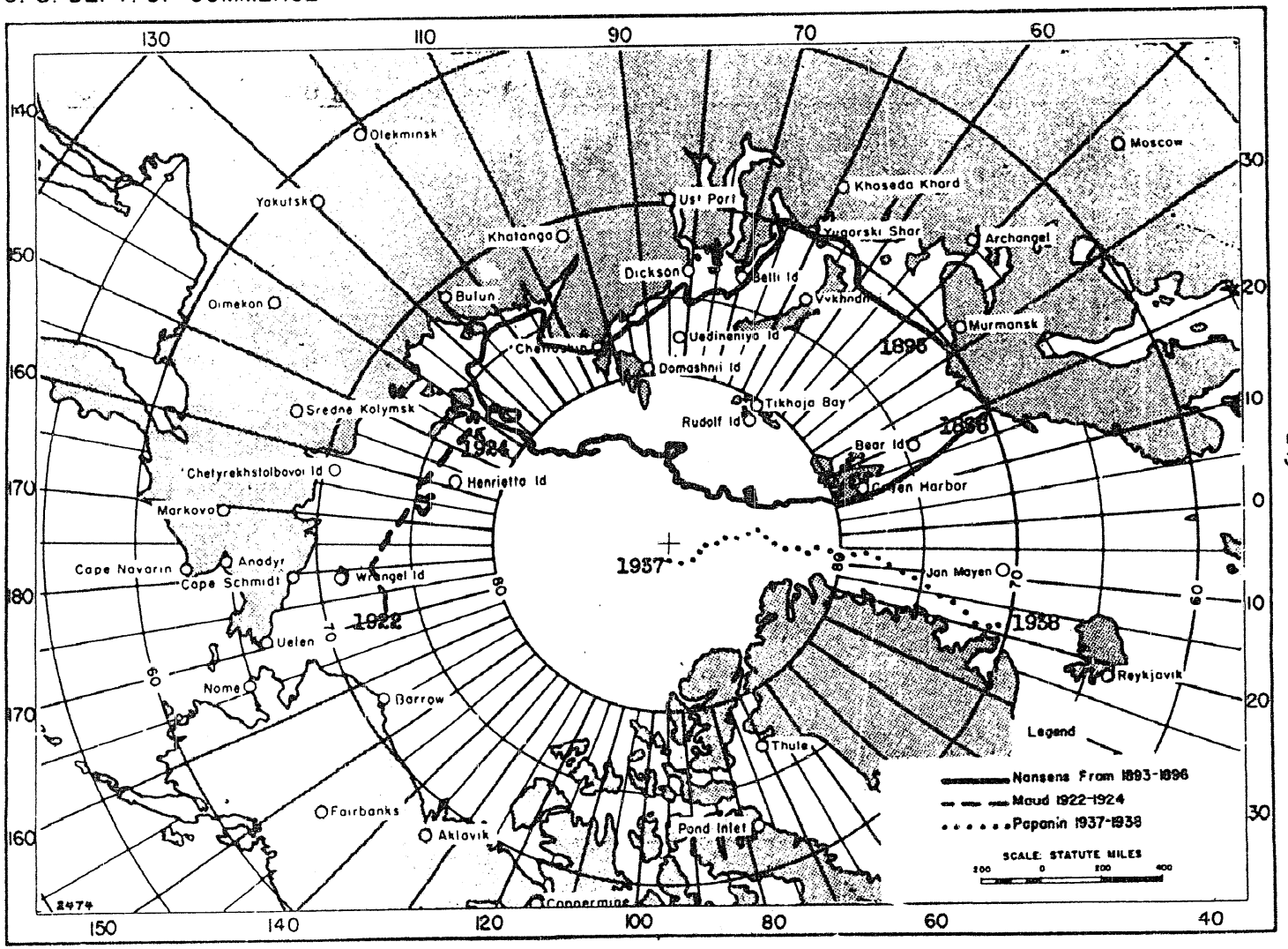

DRIFTS OF NORTH POLAR EXPEDITIONS Fig 65

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Table 78

Data from the Papanin North Polar Expedition, 1937-1938
Observation of the Drifting North Polar Station
(Observations taken 4 times daily, 0100, 0700, 1300, 1900 G.M.T.)

	May (21-31)	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb (1-19)
MEAN POSITION										
Latitude N.	89°20'	88°50'	88°20'	87°30'	86°20'	84°40'	83°30'	81°30'	77°00'	73°00'
Longitude	60° W	10° W	5° W	0°	0°	5° E	5° W	7° W	10° W	17° W
TEMPERATURE										
Mean Temperature	14.0	27.5	32.0	29.8	10.2	-5.4	-12.2	-7.1	-15.7	8.1
Highest	28.4	33.8	35.6	32.9	26.6	2.3	9.5	21.2	14.0	31.1
Lowest	2.3	17.6	28.4	17.6	-11.2	-31.9	-31.9	-31.9	-48.1	-11.7
VISIBILITY (mi.)										
Number of occurrences reported.										
0 - 1/2			60	53	32	12	1	4		
3/4 - 2 1/4			19	18	28	13	1	0		
2 1/2 - 5			13	19	19	15	0	0		
6 - 11			11	8	11	0	0	0		
12 and over			11	10	9	1	0	0		
Total reported			114	108	99	41	2	4		
Total possible			124	124	120	124	120	124		
CEILING (ft.)										
Number of occurrences reported.										
0 - 300			45	44	21	11	15	4	0	
300 - 700			0	0	2	0	0	0	0	
700 - 1000			3	1	2	0	0	0	1	
1000 - 2000			9	15	9	1	1	0	0	
2000 - 5000			21	12	11	3	0	2	0	
5000 - 8000			0	3	6	3	0	0	0	
Over 8000			35	32	43	66	61	53	34	
Total reported			113	107	94	84	77	59	35	
Total possible			124	124	120	124	120	124	124	

Note: Miscellaneous data taken from telegraphic reports.

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Table 78 (cont.)

Data from the Papanin North Polar Expedition, 1937-1938
Observation of the Drifting North Polar Station
(Observations taken 4 times daily, 0100, 0700, 1300, 1900 G.M.T.) (cont.)

	Jul	Aug	Sep	Oct	Nov	Dec	Jan
	0100 G.M.T. 1937-38						
Prevailing wind dir.	WSW	NW	W	SW	NW	N	NNW
Mean wind vel. (m.p.h.)	6.8	10.1	6.0	7.2	8.1	9.1	13.2
Mean cloudiness (0-10)	8.4	8.0	6.9	5.5	5.1	5.4	5.4
Mean pressure (mb.)	1010.7	1004.3	1007.4	1010.6	1015.6	1019.2	1016.6
Mean temperature (°F.)	32.7	30.2	9.1	-5.4	-11.9	-14.4	-20.4
Relative Humidity (%)	96	94	86	79	77	75	76
	0700 G.M.T. 1937-38						
Prevailing wind dir.	E	NW	SSW	WNW	E	N	NW
Mean wind vel. (m.p.h.)	7.7	10.6	6.0	6.4	8.1	7.2	7.2
Mean cloudiness (0-10)	8.2	9.1	8.1	5.0	3.0	5.7	4.5
Mean pressure (mb.)	1011.9	1005.8	1007.2	1010.2	1015.5	1017.3	1010.1
Mean temperature (°F.)	33.1	28.5	9.0	-6.9	-11.7	-13.4	-15.7
Relative humidity (%)	94	94	86	78	78	75	76
	1300 G.M.T. 1937-38						
Prevailing wind dir.	E	NW	WSW	W	W	N	NNW
Mean wind vel. (m.p.h.)	8.1	11.6	8.1	9.6	9.6	13.2	10.6
Mean cloudiness (0-10)	8.0	7.6	8.4	8.0	6.0	5.4	5.0
Mean pressure (mb.)	1011.9	1006.0	1007.2	1010.2	1015.7	1017.1	1011.3
Mean temperature (°F.)	32.7	29.7	10.8	-3.8	-11.4	-12.1	-16.1
Relative humidity (%)	95	93	85	78	77	75	75

Note: Miscellaneous data taken from telegraphic reports.

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Table 78 (cont.)

Data from the Papanin North Polar Expedition, 1937-1938
Observation of the Drifting North Polar Station
(Observations taken 4 times daily, 0100, 0700, 1300, 1900 G.M.T.) (cont.).

	Jul	Aug	Sep	Oct	Nov	Dec	Jan
	1900 G.M.T. 1937-38						
Prevailing wind dir.	NE	NW	SW	W	W	NNW	NNW
Mean wind velocity (m.p.h.)	8.1	11.1	8.6	7.7	8.6	9.6	11.1
Mean cloudiness (0-10)	8.0	8.1	8.7	7.4	6.0	6.1	6.4
Mean pressure (mb.)	1012.0	1006.2	1004.8	1010.5	1016.4	1017.5	1011.3
Mean temperature (°F.)	32.9	29.1	9.0	-4.7	-12.3	-14.6	-16.6
Relative humidity (%)	95	94	86	79	76	75	75

Note: Miscellaneous data taken from telegraphic reports.

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Part of 65130

Climatology of the Arctic Regions - Part I

(None)

(Not known)
U. S. Air Force, Air Weather Service, Washington, D. C.
(Same)

Part of
Special Study No. 88

(Same)

Dec '46 Restr. U.S. English 73 tables, graphs, maps

The general atmospheric circulation of the Arctic and the air masses involved, and the synoptic weather situations most frequently occurring in Arctic areas are discussed. Two features prominent on mean pressure maps of the Arctic are the Arctic anticyclone and the extension of the semipermanent Icelandic low-pressure area into the Barents and Kara Seas. Separating these two pressure areas is the Atlantic Arctic Front, along which the cyclonic disturbances of the Arctic region are most likely to develop. In January the center of the Arctic anticyclone is at about 80° N. by 165° E., with the central pressure greater than 1023 millibars. In October the Arctic anticyclone continues relatively weak and is centered in its easternmost position along the 80th parallel at the 140°W. longitude. Transposal of this center to near the Siberian border occurs with the freezing over of the East Siberian and Laptov Seas in early winter.

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SPECIAL STUDY NO. 58

AIR WEATHER SERVICE

CLIMATOLOGY OF THE ARCTIC REGIONS

PART I

DECEMBER 1946

PUBLICATIONS OF HEADQUARTERS, AIR WEATHER SERVICE

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PREFACE

Because of the ever-increasing importance of the Arctic areas for both peacetime and military activities, the Air Weather Service has received numerous requests for information concerning arctic weather. To fulfill this demand, the Air Weather Service is publishing this report on Climatology of the Arctic Regions as Special Study No. 58.

The report concerns the American, European and Asiatic Arctic and sub-Arctic regions, the continent of Greenland, and the Arctic Ocean and adjacent seas. It is arranged in three parts; Part I includes a discussion of the general atmospheric circulation of the Arctic and the air masses involved, and of the synoptic weather situations most frequently occurring in Arctic areas; Part II consists of a detailed discussion of certain weather factors such as visibility and illumination, cloudiness and ceilings, temperature, precipitation, snow-cover and sea-ice; and Part III includes tables and graphs of climatic data, and a bibliography.

Special attention is called to the bibliography (Part III) which is quite complete and may be a particular aid to those desiring to delve further into the subject of Arctic weather.

The report was written in the later part of 1942 and at that time was a comprehensive compilation of all available material. Since then considerable information on the Arctic has accumulated, but it is believed that the conclusions presented in this report would not be greatly modified by the more recent data. The report was originally written to fulfill a specific request and was not intended as a general study of Arctic climatology. Certain information included for the original purpose of the report is no longer applicable and has been deleted, leaving some apparent breaks in continuity.

The material for the report has been drawn from many sources as shown by the bibliography. The data, however, are fragmentary and are usually for short, non-simultaneous periods. Moreover, large portions of the area are not represented by any observational data. It should be emphasized that in most sections of the Arctic, weather conditions vary greatly from year to year, and in any particular year conditions may be exceptionally good or exceptionally poor compared with average conditions.

Funds for this report were supplied by the Army Air Forces, Air Weather Service, and the report was prepared by personnel of the Statistics Division of the United States Weather Bureau.

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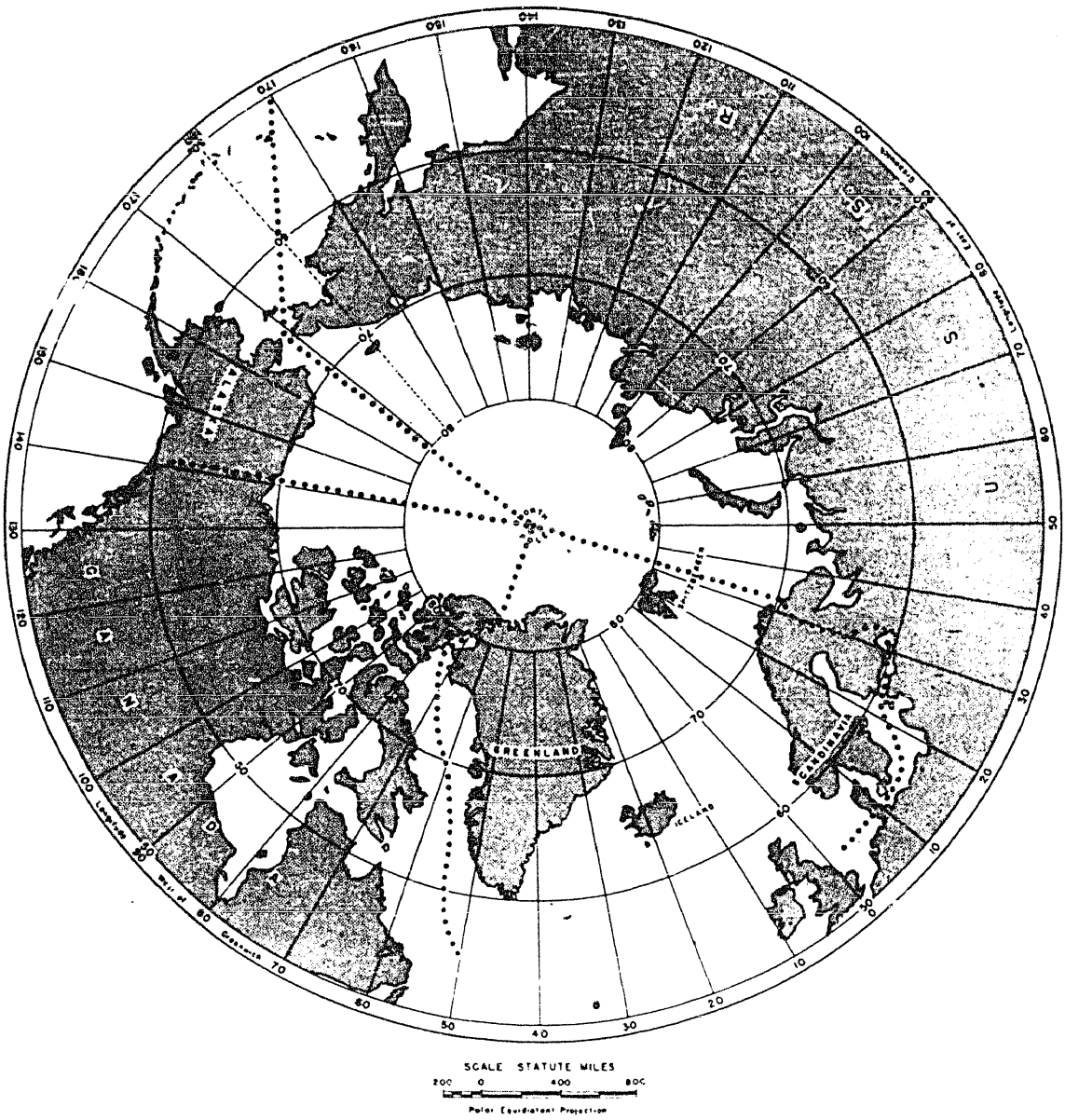

Figure 1. Principal Divisions of the Arctic

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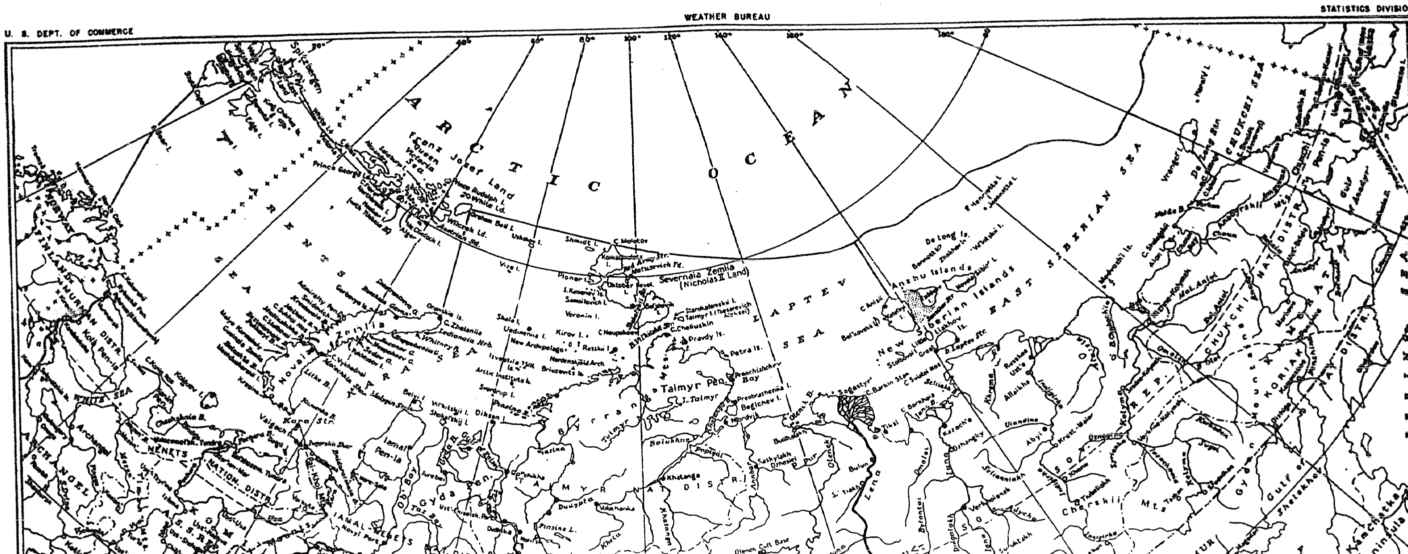

Figure 2

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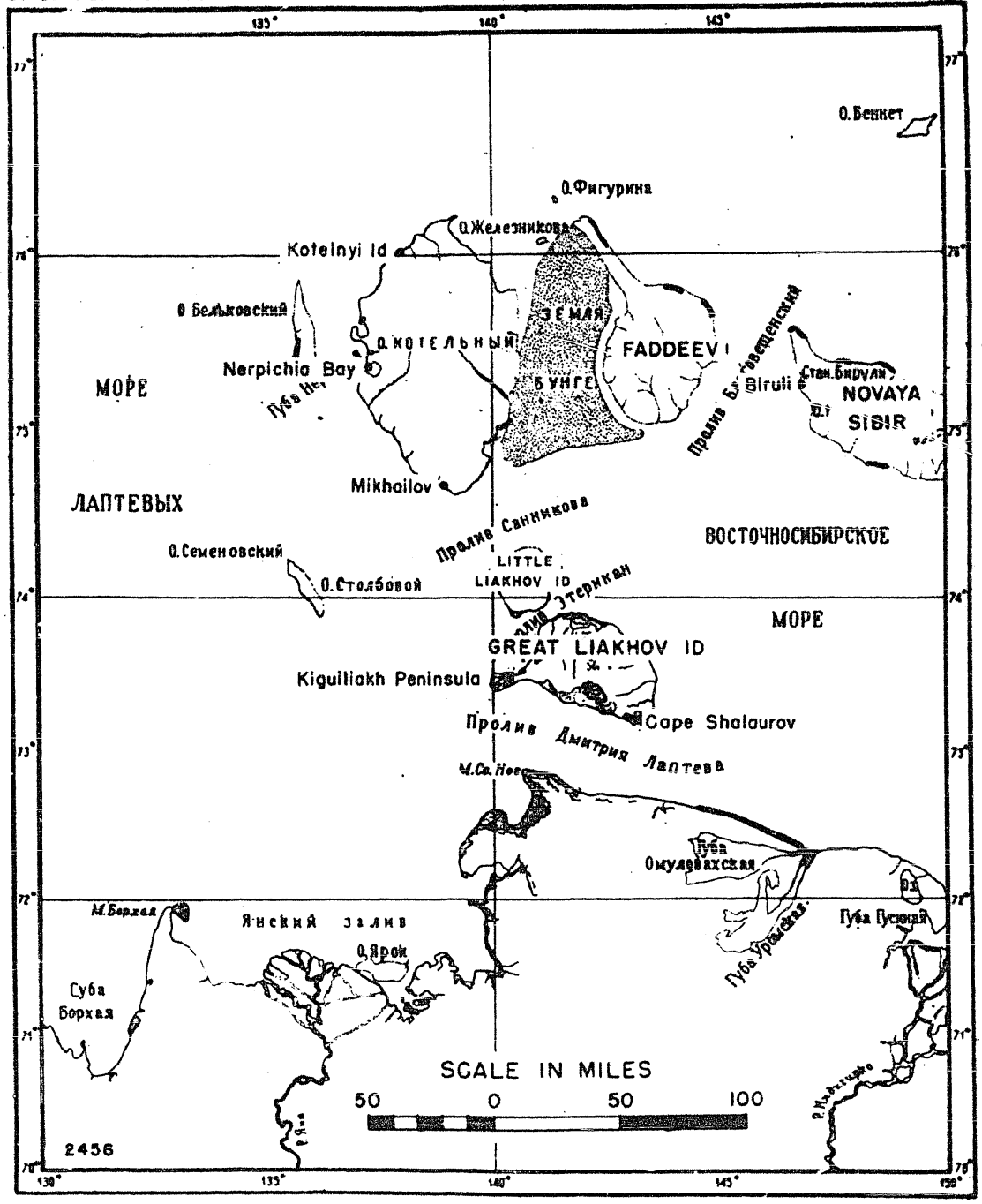

LOCATION OF STATIONS IN NEW SIBERIAN ISLANDS

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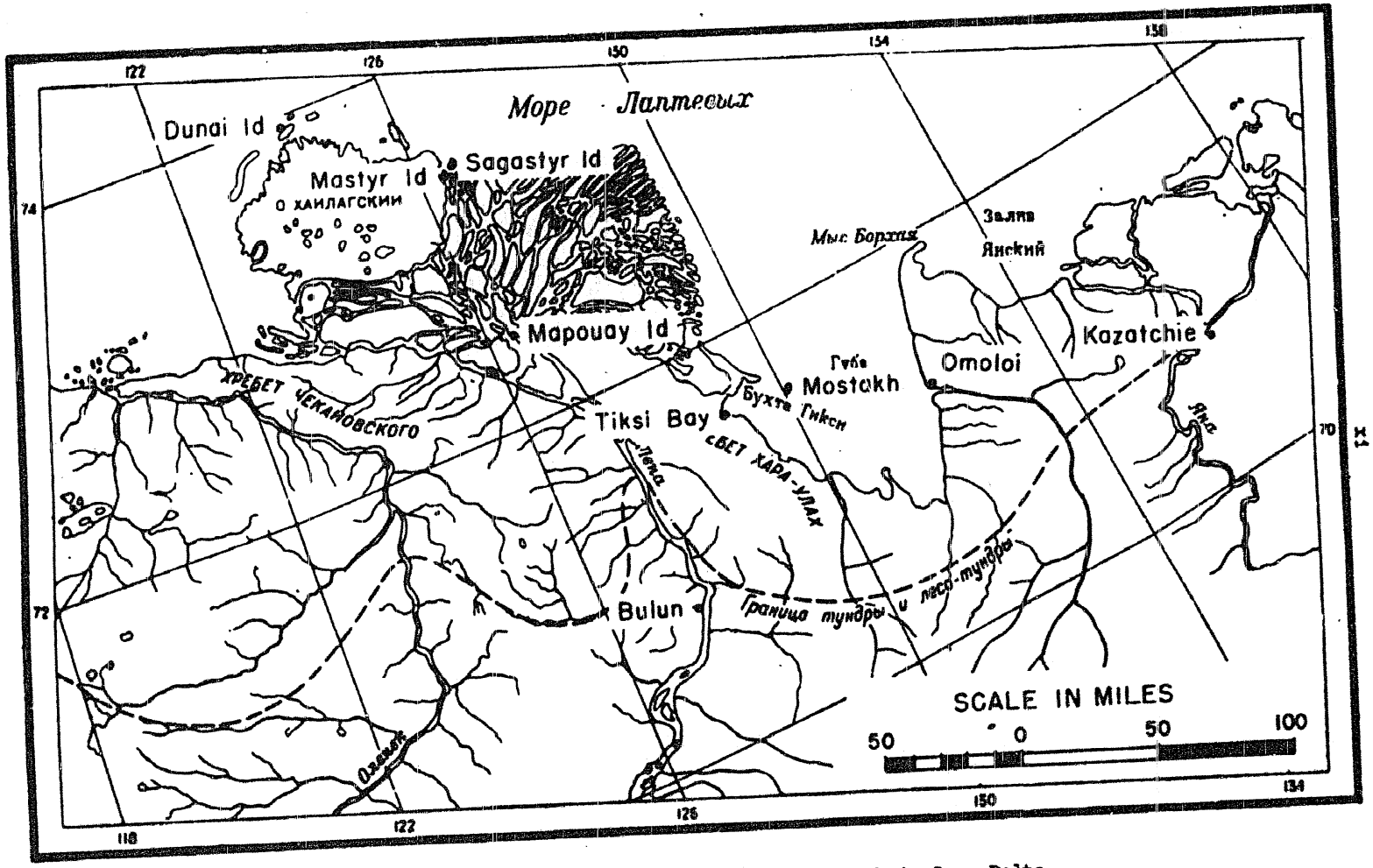

Figure 4. Location of Stations in the Region of the Lena Delta

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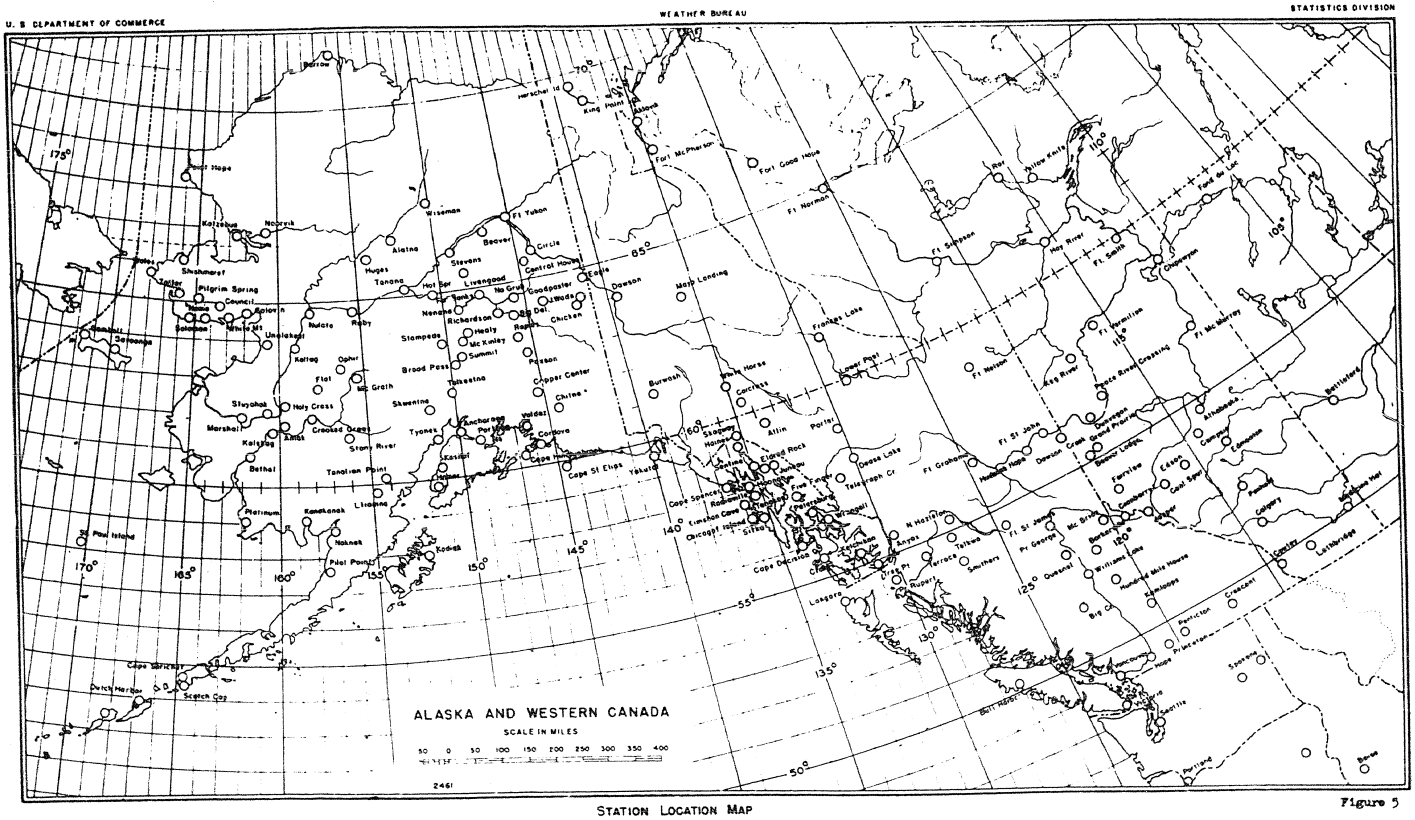

STATION LOCATION MAP

Figure 5

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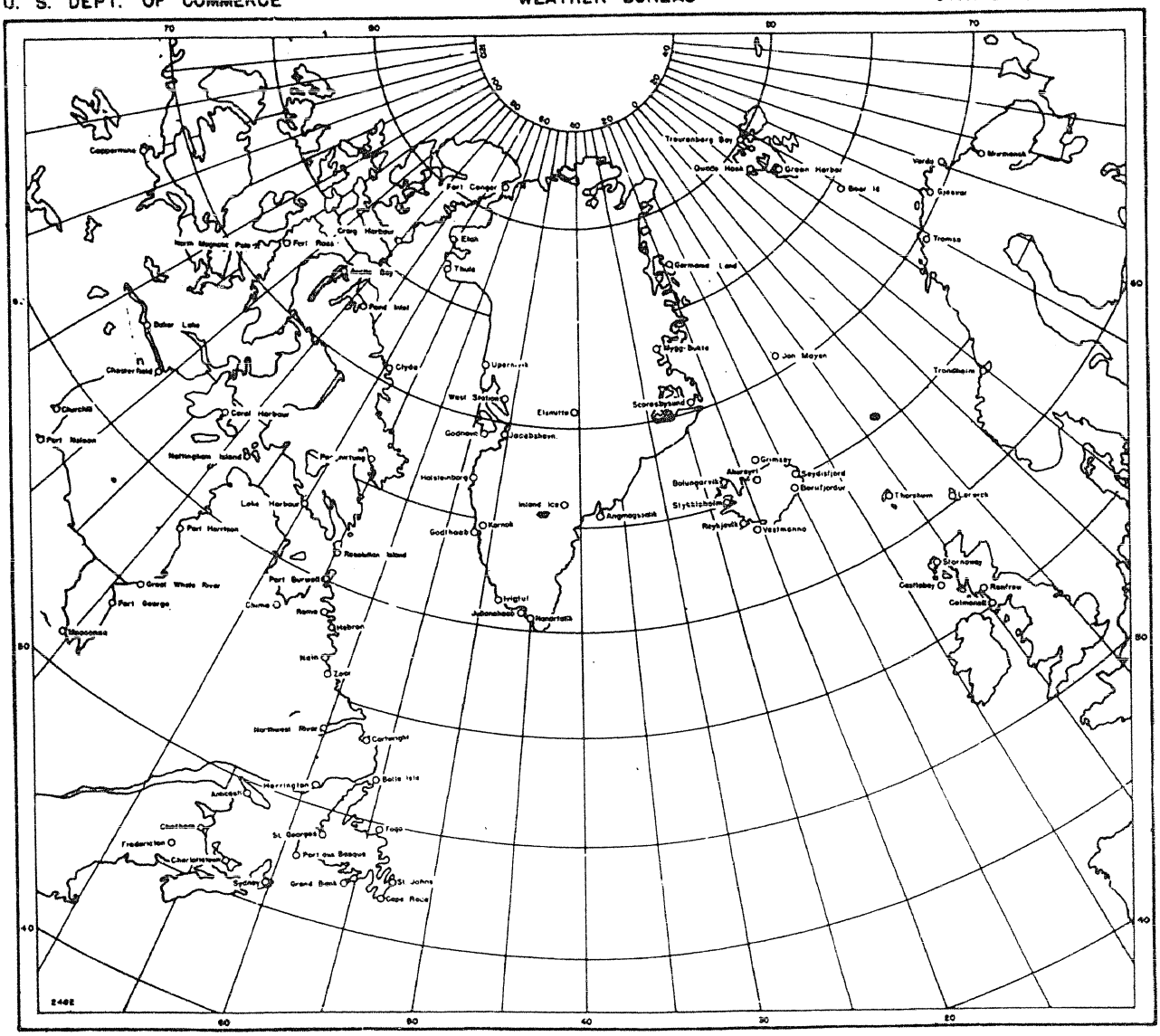

Figure 6. Station Location Map of North Atlantic

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Table 1

STATION LOCATION TABLE

Station	Latitude N	Longitude W	Elevation Feet
ALASKA			
Anchorage	61° 13'	149° 52'	132
Barrow	71 23	156 17	25
Bethel	60 45	161 47	38
Council	*64 54	*163 42	
Dutch Harbor	53 53	166 32	13
Eagle	64 46	141 12	833
Fairbanks	64 51	147 43	454
Fort Yukon	66 34	145 18	417
Gambell	63 51	171 36	27
Hot Springs	64 59	150 40	270
Juneau	58 18	134 24	80
Nenana	64 03	149 06	350
Nome	64 30	165 24	22
Nulato	64 43	158 04	*100
Pilgrim Springs	*65 05	*164 56	
Ruby	*64 44	*155 26	722
Shishmaref	66 08	166 15	12
Solomon	*64 32	*164 25	
St. Paul Is.	57 15	170 10	20
Tanana	65 10	152 06	218
Wales (Tin City)	*65 36	168 03	
CANADA			
Aklavik	68 14	134 50	25
Atlin	59 35	133 38	2240
Banks Strait	*73 48	*114 54	
Barrow Strait	*74 06	*92 24	
Beaver Lodge	55 10	119 19	2500
Calgary	51 02	114 02	3540
Cambridge Bay	69 05	105 00	15
Chesterfield	63 20	90 43	13
Chimo	*58 07	*68 16	
Chipewyan (Fort)	58 43	111 09	72
Churchill	58 47	94 11	43
Clark City	50 12	66 38	186
Clyde	70 29	68 40	
Coppermine	67 49	115 10	13
Coral Harbour	64 12	82 33	32

*Approximately

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Table 1 (cont.)

Station	Latitude N		Longitude W		Elevation
CANADA (cont.)	°	'	°	'	Feet
Craig Harbour	76	12	79	35	12
Cumberland Sound	* 66	30	* 67	06	
Dawson	64	03	139	22	1050
Dawson Creek	* 55	47	* 120	15	
Edmonton	53	33	113	30	2219
Fond du Lac	* 59	22	* 107	12	
Fort Conger	81	44	64	45	
Fort George	53	50	79	05	318
Fort Good Hope	66	15	128	38	214
Fort McMurray	56	44	111	23	* 829
Fort McPherson	67	26	134	53	151
Fort Nelson	58	49	122	35	970
Fort Norman	64	54	125	30	* 300
Fort Resolution	61	10	113	40	520
Fort Simpson	61	52	121	15	* 415
Fort Smith	60	00	111	52	* 680
Fort Vermilion	58	23	116	03	951
Foxe Channel	* 67	12	* 84	42	
Gjoahavn	68	38	95	55	
Goose Fiord	76	49	88	39	
Great Whale River	55	17	78	20	50
Hay River	60	51	115	57	529
Herschel Is.	* 69	36	* 139	02	
Hudson Hope	56	05	121	55	1606
Kane Basin	* 78	42	* 73	48	
Keg River	57	49	117	53	1402
King Point	69	07	136	08	
King William Land	68	37	95	53	
Lady Franklin Bay	* 82	00	* 63	06	
Lake Harbour	62	50	69	55	54
Lethbridge	49	43	112	51	3018
Martins Falls	* 51	50	* 86	18	
Mayo Landing	63	35	135	51	1625
Medicine Hat	50	01	110	37	2365
Mistassini Post	50	30	73	55	1266
Moose Factory	51	14	80	30	30
Nain	56	33	61	40	13
Northwest River	53	34	60	06	46
Norway House	53	59	97	50	720
Nottingham Island	63	07	77	56	* 54

* Approximately

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Table 1 (cont.)

Station	Latitude N ° '	Longitude W ° '	Elevation Feet
CANADA (cont.)			
Ottawa	45 24	75 43	236
Pangnirtung	66 09	65 30	50
Pond Inlet	72 43	78 30	13
Port Harrison	58 25	78 21	12
Port Nelson	57 04	92 36	49
Rae	62 50	116 04	* 525
Resolution Island	61 18	64 53	* 127
Sherbrooke	45 24	71 53	620
Simpson Strait	* 69 36	* 96 48	
The Pas	53 49	101 15	860
Vancouver	49 17	123 05	22
Watson Lake	59 55	128 45	1830
Winter Harbour	74 47	110 48	5
Whitehorse	60 50	135 00	
Winnipeg	49 53	97 07	760
GREENLAND			
Angmagssalik	65 36	37 34	236
Camp Scott	72 49	55 06	
Danmarkshavn	76 46	18 45	20
East Station	* 71 10	* 24 24	
Eismitte	70 54	40 42	9842
Etah	78 20	72 42	
Godhavn	69 14	53 31	26
Godthaab	64 10	51 44	102
Holsteinsborg	66 56	53 39	89
Ivigtut	61 12	48 10	82
Jakobshavn	69 13	51 02	102
Julianehaab	60 43	46 03	213
Kornok	64 26	50 58	10
Mt. Evans	66 51	50 55	
Mygg-Bukta	73 29	21 34	10
Manortalik	60 08	45 11	23
Scoresbysund	70 29	21 58	230
Thule (North Star Bay)	76 30	68 55	23
Upernavik	72 47	56 07	59

* Approximately

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Table 1 (cont.)

Station	Latitude		Longitude		Elevation
ICELAND	N		W		Feet
	°	'	°	'	
Adlavik	66	18	23	06	10
Akureyri	65	41	18	05	23
Berufjord	64	41	14	22	59
Grimsey	66	33	18	01	72
Reykjavik	64	09	21	57	52
Stykkishólmur	65	05	22	46	36
Westmann Is. (Vestmannaeyjar)	63	24	20	17	400
U.S.S.R. (Asia)	N		E		Feet
	°	'	°	'	
Alexandrovski Post	50	54	142	10	52
Amga	60	54	131	59	554
Anadyr	64	47	177	34	16
Ayan Is.	69	52	167	52	
Barnaul	53	20	83	48	518
Blagoveshchensk Priisk	58	10	114	19	1608
Belii Is.	73	20	70	00	
Borsia	50	24	116	29	2247
Bulun	70	45	127	47	115
Cape Cheliuskin	77	43	104	17	20
Cape Navarin	62	18	179	03 W	
Cape Schmidt	68	55	179	29 W	30
Cape Serdze Kamen	66	53	171	38 W	
Cape Shalaurov (Great Lyakov Is.)	73	11	143	14	26
Cape Sholagski	70	05	170	34	20
Cape Zhelaniia	76	57	68	35	26
Chetyrekhstolbovoi Is.	70	38	162	24	20
Chita	52	03	113	29	2182
Chumikan	54	45	135	15	16
Dickson Is.	73	30	80	24	66
Domashnii Is.	79	30	91	08	7
Dudinka	69	24	86	09	
Dunai	73	55	124	30	
Elgiai	62	46	116	56	443
(Prof)ei) Pavlovich	53	58	121	56	1716
Four Pillar Is.	70	43	165	25	
Great Lyakov (ski) Is. (Cape Shalaurov)	73	11	143	14	26
Igarka	67	27	86	35	115

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Table 1 (cont.)

Station	Latitude N		Longitude E		Elevation Feet
	°	'	°	'	
U.S.S.R. (Asia) (cont.)					
Irkutsk	52	20	104	13	1434
Kazachie	70	46	136	14	95
Kulakan	55	09	116	47	
Khabarovsk	48	28	135	03	151
Khatanga	71	59	102	28	230
Kirensk	57	47	108	07	879
Kolpashevo	58	18	82	54	* 262
Komsomolsk	50	33	136	59	95
Komsomolsk Pravdy Is.	77	26	106	40	
Kozyrevskaia	56	02	159	53	* 148
Krasnoyarsk	56	02	92	45	879
Malye Karmakuly	72	23	52	44	49
Mapouay Is.	72	29	126	21	
Mare Sale	69	43	66	48	56
Markovo	64	41	170	25	
Mastyr Is.	73	33	126	36	
Matochkin Shar (Vykhodnoi)	73	16	56	24	59
Mostakh	71	35	128	55	16
Nagayevo, Bukhta	59	33	150	47	387
Nagorni	55	38	125	31	2844
Naiakhan	61	55	158	59	95
Nerchinsk Zavod	51	19	119	37	2054
Nikolaevsk on Amur	53	08	140	45	56
Nizhne Kolymsk	68	32	160	55	26
Nordvik Bay	74	01	111	29	
Noraya Siber Is.	* 75	00	* 147	00	
Novyi Port	67	42	72	57	13
Obdorsk	66	31	66	35	79
Ocha	53	38	142	56	36
Oimyakon	63	28	142	45	
Okhotsk	59	21	143	17	16
Olekminsk	60	23	120	24	486
Olga	43	44	135	16	26
Petropavlovsk	54	53	69	07	446
Preobrazhenia Is.	74	40	113	45	
Prenchishchev Bay	75	40	113	04	
Rodchevo	66	18	152	40	197
Rudolph Is.	81	48	57	57	154
Russkaia Gavan	76	12	62	35	29

* Approximately

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Table 1 (cont.)

Station	Latitude N ° '	Longitude E ° '	Elevation Feet
U.S.S.R. (Asia) (cont.)			
Russkoe Ustc	71 01	149 26	20
Sagastyr Is.	73 23	126 36	
Seimchan	62 54	152 25	666
Semenovsky Rudnik	64 00	132 00	3346
Sredne Kolymsk	67 27	153 44	89
Surgut	61 15	73 24	* 131
Tikhaja Bay	80 19	52 48	
Tiksi Bay	71 35	128 56	33
Tilichiki	60 26	166 03	16
Tobolsk	58 12	68 14	* 328
Turukhansk	65 47	87 57	148
Uedineniya Is.	77 30	82 12	33
Uelen	66 10	169 50 W	23
Ust Belaya (Ustie Beloi)	65 30	173 22	* 82
Ust Maiskaya	60 25	134 32	584
Ust (Eniseisk) Port	69 40	84 24	82
Vaigach	70 24	58 48	36
Verkhoyansk	67 33	133 24	400
Viliuisk	63 46	121 37	449
Vykhodnoi (Matochkin Shar)	73 16	56 24	59
Wrangel Is.	70 58	178 33 W	10
Yakutsk	62 01	129 45	354
Yugorski Shar (Yugor Strait)	69 49	60 46	43
Zhigansk	66 45	123 24	194
U.S.S.R. (Europe)			
Archangel	64 34	40 31	33
Kargopol	61 30	38 57	397
Kem	64 58	34 39	26
Kola	68 53	33 01	23
Kolguev	69 32	49 08	23
Leningrad	59 59	30 17	16
Moscow	55 47	37 38	528
Murmansk	68 57	33 03	151
Mezen	65 50	44 16	72
Perm	58 01	56 16	515
Ust Zylma	65 27	52 10	220

Note: In Russian spellings ts is equivalent to z and i, Y and i are sometimes used interchangeably.

* Approximately

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Table 1 (cont.)

Station	Latitude N		Longitude E		Elevation Feet
	°	'	°	'	
NORWAY					
Bodö	67	17	14	26	56
Gjesvar	71	06	25	22	20
Karasjok	69	28	25	31	443
Tromsö	69	39	18	57	335
Trondheim	63	26	10	25	210
Vardö	70	22	31	06	39
Bear Is.	74	28	19	17	133
Jan Mayen	70	59	8	20 W	75
SPITSBERGEN					
Green Harbor	78	02	14	15	36
Kings Bay	78	50	12	30	
Quade Hook	78	57	11	42	33
Treurenberg Bay	79	50	17	10	
FINLAND					
Inari	68	57	26	49	502
Kajaana	64	13	27	46	479
Petsamo	69	33	31	13	43
Viipuri	60	43	28	45	26
SWEDEN					
Karesuando	68	27	22	30	1093
Skara	58	24	13	27	377

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C L I M A T O L O G Y O F T H E A R C T I C R E G I O N S

GENERAL CIRCULATION

In any discussion of the general circulation in the Arctic region it must always be remembered that the available records are for very short non-concurrent periods of time for most of the stations within the Arctic Circle. Any deductions arrived at from these data are necessarily subject to revision at a later date when more complete data may be available.

Two features are prominent on mean pressure maps of the Arctic. They are, first, the Arctic anticyclone, and second, the extension of the semi-permanent Icelandic low pressure area into the Barents and Kara Seas. These features are best developed in the late winter and early spring and poorly developed in late summer and early autumn. Separating these two pressure areas is the Atlantic Arctic Front, along which the cyclonic disturbances of the Arctic region are most likely to develop.

In January the center of the Arctic anticyclone will be found at approximately 80° N. by 165° E., with the central pressure greater than 1023 millibars. In 1924, near the southern edge of this anticyclone, the "Maud" recorded a mean pressure of 1031 millibars. This figure may be accepted as indicative that in some years the anticyclone is more intensive than in other years. The Icelandic low pressure area is extended northeastward from Iceland beyond northern Novaya Zemlya, its central axis marked by the mean position of the Atlantic Arctic Front which extends intermittently along the northern Siberian coast to 170° W. longitude. At this season an almost continuous succession of cyclones is to be noted along the Arctic Front between Bear Island and Novaya Zemlya. East of Novaya Zemlya, the disturbances fill rapidly and few storms penetrate along the east Siberian coast. Surface winds are prevailingly from a westerly direction along the Siberian coast, easterly over the central Arctic regions and most of Greenland and north to northwest over the Canadian Archipelago.

In April, the winter pattern of mean pressure in the Arctic is continued with but little change. The Arctic anticyclone shifts slightly eastward to the 180th meridian and the central pressure continues high. Pressures are slightly higher in the Icelandic low pressure cells and fewer intense cyclones develop or move along the Atlantic Arctic Front. With the eastward shift of the Arctic anticyclone the winds become more variable along the northern Alaska coast.

In July, the pressure gradients are weakest over the entire Arctic region and the winds are quite variable. A separate anticyclonic center occurs to the east of Greenland, while the principal Arctic anticyclone has continued its eastward movement along the 80th parallel to approximately the 155° W. meridian but with greatly diminished intensity. Winds are prevailingly northeasterly along the Alaskan and Siberian coasts and north to northwest over the Canadian Archipelago. Cyclonic storms, while few in number, may penetrate any section of the Arctic at this season.

In October, there is an increase in cyclonic activity along the Arctic Front which extends from southern Greenland through Iceland off the northern coast of Norway across southern Novaya Zemlya and the Taimyr Peninsula. Winds are prevailingly westerly south of the front and prevailingly easterly north of the front. The Arctic anticyclone continues relatively weak

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and is centered in its easternmost position along the 80th parallel at the 140° W. longitude. The transposal of this center to near the Siberian border takes place simultaneously with the freezing over of the East Siberian and Laptev Seas in early winter.

ARCTIC AIR MASSES

Classification

Air masses are classified, in general, according to source and recent life history. The simplest method of designation would allow four types of air, and would apply to any part of the earth. These four broad types, according to F. Linke (Ref. 37), are:

cP: Continental Polar cT: Continental Tropical

mP: Maritime Polar mT: Maritime Tropical

In a discussion of air masses over a particular region, however, it is desirable to use a more specialized scheme, since air from different geographical regions of the same general type, assumes characteristics peculiar to the source region which help materially in analysis and forecasting. For example, Polar air which has lain for days over the almost unbroken ice-pack north of Bering Strait in the total darkness of the Arctic winter, will show, in general, marked similarity to a mass of Polar air from the sub-Polar plateau of Outer Mongolia; but in the Arctic air, in addition to the strong inversion of temperature in the lower 5,000-foot layer, there will be found in most cases a characteristic 500-foot layer at the very surface in which the temperature falls rapidly with height, and the surface layer will show higher humidity, while at the top of the troposphere (at about 30,000 feet) the temperature will be somewhat lower than at the same altitude in the sub-Polar air. So it is customary to differentiate the two types of air by adding the following types to the above classification:

cA: Continental Arctic mA: Maritime Arctic

and to add the letter W or K to any of the above types to show whether the air is warm or cold with respect to the surface over which it is moving (stable or unstable).

Thus, in the Arctic and sub-Arctic regions we have the following types according to the specialized scheme of Schinze (Ref. 37), together with the general source region, and the season or seasons of occurrence:

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Table 2

Main Source Regions, Arctic Air Masses

Type	Main Source Region	Season of Occurrence
mAK	Greenland-Spitzbergen	Entire year except July and Aug.
cAK	Novaya Zemlya-Canadian Archipelago-Pole	" " " " " "
mPK	North Atlantic	Entire year
cPK	Scandinavia-Siberia North	Northern Winter (Sept.-June)
mPW	Atlantic and Pacific (around 50° lat.)	Northern Winter
cPW	Ukraine-Mongolia	Northern Spring, Summer, and Fall
mTW	Azores (Middle Atlantic) Anticyclone	Entire year

(It would be practically impossible to have mTK, cTW, or cTK air invade the Polar regions at any time of the year. Therefore, these types will not be considered.)

An even more specific classification is used by many authors in America (Byers and Willett) and in Europe in order to designate the exact geographical region over which the air mass has lain for some time. Thus, we may see on older maps some of the following symbols:

Pp:	Polar Pacific	Tp:	Tropical Pacific
Pa:	Polar Atlantic	Ta:	Tropical Atlantic
Pc:	Polar Canadian	Ts:	Tropical Superior
Ps:	Polar Siberian	To:	Tropical European

This last system is very useful in a regional discussion as it gives the reader not only an idea of the type of air under consideration, but of the direction and source from which the air came. The dynamic scheme given in table 1 is generally accepted by forecasters and analysts, however, and the symbols used in that table will be found on most recent maps. Such a scheme is internationally applicable.

Horizontal Temperature Variations

The temperature of an air mass will be determined by the latitude, altitude, and continentality of the source region and it will be somewhat modified by the topography, and by the nature of the surface (aside from whether or not it is land or ocean) over which the air mass moves or lies.

In the Arctic, the latitudinal effect is not as pronounced as one would expect from the consideration of the entire lack of sunlight during the Arctic winter, and from the accounts of extreme cold in the Antarctic which leads the uninformed to reason that the same conditions exist in the Arctic because of the astronomical similarity between the two Polar regions. Table 2 shows that the average annual temperature difference between 50° and 90° for the entire earth is 1.28° F. in the Northern Hemisphere, and 1.60° F. in the Southern Hemisphere, for each degree of

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latitude. In winter the figures are 1.53° and 2.02°, and in the summer .86° and .86° in the Northern and Southern Hemispheres, respectively. The difference in winter reflects the effect of continentality, for in the Northern Hemisphere the change from 50° to 90° is from 58% land to 0% land, while in the Southern Hemisphere the continentality is reversed, there being only 2% land at 50° against 100% at the South Pole.

Table 3

Latitudinal Effect on Temperature (°F.)

Lat.	N.Jan.	N.Jul.	%Land	S.Jul.	S.Jan.	%Land	N.Yr.	S.Yr.
50°	19.2	64.6	58	26.6	46.9	2	42.4	41.9
60°	3.0	57.4	61	13.5	34.2	0	30.0	24.6
70°	-15.3	45.1	53	-11.0	29.7	71	12.7	8.1
80°	-26.0	35.6	20	-33.3	18.7	100	1.0	-12.5
90°	-41.8	30.2	0	-43.6	12.2	100	-8.9	-22.0

Thus, the lowest mean temperature is at the South Pole in July at the center of the region of greatest continentality and least winter insolation. In the Northern Hemisphere the greatest continentality is at 65° N. where the earth is 76% land, as against 0% at the North Pole.

Next to latitude, altitude has the most important effect on the temperature of the air masses. Due to the greater amount of air and water vapor between the surface and outer space, an air mass over land at sea level will be warmer than one over a plateau which is at, let us say, 9,000 feet elevation, like the Inland Ice Cap over Greenland, even though both air masses are in the same latitude and granted that other things are equal. The average temperature difference between air masses at sea level and various elevations is given in table 4. These values are by no means absolute for all conditions and regions of the earth.

Table 4

Effects of Elevation on Mean Temperatures (°F.)

Elev.(ft.s.l.)	Temp. Diff. (°F.)	Elev.(ft.s.l.)	Temp. Diff. (°F.)
sea level	0	6000	-18°
1000	-3°	7000	-21°
2000	-6°	8000	-24°
3000	-9°	9000	-27°
4000	-12°	10,000	-30°
5000	-15°	11,000	-33°

Actual measurements give values 20% higher or 25% lower for various latitudes and seasons of the year and distances from the oceans, etc. Thus, a mountain or plateau 10,000 feet high in the Tropics in the path of the prevailing winds in summer might be 40° or more cooler than at sea level, while a 10,000-foot plateau in the Arctic in winter and far from the ocean would have a temperature only 20° lower than it would at sea level. Thus, we could say that the Greenland Ice Cap would be 30° colder, on the average, than a similar area at sea level, and this value is fairly consistent with observed values. (See charts 55-56.)

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In table 5 the effect of continentality on a region is shown strikingly. The summer temperatures are consistently about 18° F. higher in the Northern Hemisphere than in the Southern, while in winter the Antarctic is with 0% land 10.5° warmer than the Arctic with 61% land at latitude 60°, while at latitude 80° the Antarctic with 100% land is 7.3° colder than the Arctic at the same latitude where only 20% land exists. Thus the reversal in temperature, or anomaly, amounts to 17.8° in winter, due largely to the greater land mass at higher latitudes in the southern Polar regions, and the greater water area, albeit that water is mostly ice-covered and considered by some to be continental in character, in the Arctic. This reversal of continentality has as much effect as an increased elevation of 6,000 feet, or an increased latitude of over 10° would have.

The following table shows the effect of distance from the ocean on mean temperatures along a parallel of latitude:

Table 5

Effects of Continentality on Temperatures (°F.)

	Eurasian Stations, Lat. 52° N.						
Sta.	Valentia	Warsaw	Kursk	Orenburg	Omsk	Irkutsk	Nikolaevsk
Long.E.	-10°	21°	36°	55°	73°	105°	140°
Jan.	44.2	24.3	14.2	4.3	-3.3	-5.6	-12.1
Jul.	58.2	65.3	66.7	70.9	66.4	63.0	62.1
Yr.	50.2	45.0	41.4	37.9	31.9	29.6	27.7
Var.	14.0	41.0	52.6	66.6	69.7	68.6	74.2

	Mean Temp. Stations Lat. 62°			Stations Lat. 67°		
Sta.	Thorshaven	Yakutsk	Diff.	Bodo	Verkhoyansk	Diff.
Long.E.	-7°	129°	136°	12°	133°	121°
Jan.	36.7	-45.9	82.6	27.1	-58.2	85.3
Jul.	50.4	66.4	-16.0	53.8	59.9	-6.1
Yr.	42.6	12.7	29.9	38.8	3.4	35.4
Var.	13.7	112.3	98.6	26.7	118.1	91.4

Thus, at 52° N. the difference in January mean temperature per 10° longitude from Valentia to Warsaw is 6.4°, and to Omsk 5.7°. The annual difference is 1.7° and 2.2° per 10° longitude, respectively. From the values for temperature difference along a parallel of latitude in table 5, and from the temperature differences in a north-south direction as given in table 3, the values in the following table were computed to show the approximate effect that distance from the Atlantic Ocean has on temperature during January, July, and for the year, and on the variability from January to July, compared with the latitudinal temperature effect. Values are indicated as positive where the temperature falls as one proceeds in an easterly or a northerly direction, and negative when the temperature rises towards the east or north. Since 10° of latitude equals about 690 miles in these latitudes, while 10° of longitude is much less and varies with the latitude, the following table was based on a 1000-mile range in latitude or longitude so as to be comparable. Along the 52° parallel the values given are for the difference between Valentia and Omsk (83° longitude difference). For the 62° parallel the difference between Thorshaven and Yakutsk (136° longitude difference) was

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computed, while along the 67° parallel the Bodo-Verkhoyansk data, covering a range of 121°, were used. The values for latitudinal difference were obtained by taking the difference between 50° and 55° N., between 60° and 65°, and between 65° and 70° for the 52°, 62°, and 67° values, respectively.

Table 6

Latitudinal and Longitudinal Mean Temperature (°F.) Change (per 1000 miles) in Eurasia

	January		July		Annual		Variability	
Lat.	W-E	S-N	W-E	S-N	W-E	S-N	W-E	S-N
52°	12.7	23.4	-2.2	11.9	5.8	18.6	14.8	7.1
62°	13.6	28.6	-2.7	12.9	5.8	22.9	16.0	26.3
67°	15.6	20.9	-1.1	20.3	6.7	23.7	16.7	-9.3

It appears from this table that in January the temperature drops off about one half as fast as one goes east from the Atlantic, as it does as one goes north from 50° to the Arctic.

From table 5 it is apparent that the effect of continentality depends, not alone on the distance from the ocean, although the rate of decrease as one goes east from the Atlantic is fairly constant for 4,000 miles, but on the prevailing direction of winds and the temperature of the water off the respective coasts. Also the presence of a mountain barrier along a coast, as in America, tends to increase the rate of temperature drop in an easterly direction during the winter, and the rate of temperature increase in summer along a parallel of latitude. Thus, in America along the 55th parallel there is as great a drop in the January mean temperature going from Prince Rupert, B.C. to Prince Albert, Sask. (39° F.) as from Lethbridge, Alb. to Ft. Simpson, N.W.T. (34° F.), both a distance of about 1000 miles. Compare these values with those in Europe where a similar distance from the Atlantic, with no appreciable mountain barriers, gives values of 13° and 23° for the east-west and north-south directions, respectively.

All of the stations in the Northeast Atlantic show temperatures about 40° F. higher than the mean temperature for the respective latitudes, during January, even as far north as Spitzbergen, while the Northwest Pacific ports from Vladivostok to Bering Strait show a somewhat smaller negative anomaly. The large anomalies in ocean temperatures show the proportion of the air temperature anomalies that is due to the water effect, and it can be assumed that the remainder of the anomaly is due to the effect of prevailing winds.

Besides the continental, oceanic, latitudinal, and wind influences on temperature of air masses, there are a number of minor controls which should be investigated further, as the magnitude of these controls are at present uncertain. It is thought that a snow surface radiates more efficiently into space than, let us say, an ice or rock, sand or grass surface. Certainly a snow surface reflects more of the incoming solar radiation than a duller surface would, so that very low temperatures are maintained in the sub-Arctic during the winter when snow is on the ground, even when the sun feels very warm to the skin. Likewise, in the true Arctic there is less

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warming from the sun in the spring and fall when the ground or ice is snow-covered than would be expected from the elevation of the sun. Thus, it is possible for quite cold air masses to develop in the Arctic as late in the year as May, or as early as September.

In addition to the barrier effect of mountains in the path of the prevailing winds as just mentioned, there are two distinct types of physiographical formation which markedly affect the formation of cold air masses. First there is the bowl-shaped, or amphitheater type of depression where the cold air accumulates in the absence of strong winds or turbulence, allowing a considerable high to form and stagnate. Any plateau surrounded by mountains such as those in Mongolia, or smaller ones in the Northern Rockies, illustrate this type of Basin High. Verkhoyansk, the coldest inhabited spot on earth and the center of anticyclogenesis for a great portion of the sub-Arctic is in the heart of an amphitheater with high ranges to the west, south, and east, but open to the north.

There in the Yana, and in the neighboring Lena Basins, the prevailing cold northerly winds accumulate a mass of cold air, further cooled by radiation and reflection from the snow surface, and by the slight upslope motion of the air, which cold air cannot escape until it has built up to the height of the passes. Pressures of over 1050 millibars are common in this region, and the influence of such cold masses on those in the vicinity is considerable. This "basin" effect partially accounts for the fact that the coldest spot on the globe is near, instead of far north of the Arctic Circle as one might expect. The logical spot for such a "Cold Pole" would be the center of the Greenland Ice Cap at about the 78th parallel, for here there is a possible 30° lower temperature due to altitude, a 12° lower temperature due to the higher latitude and an equal distance from the warm oceans, or continentality. But instead of being 42° warmer in January, the Verkhoyansk area averages about 20° colder than the coldest area in northern Greenland. This can be explained by the fact that Greenland, instead of being a "basin" is in the form of a "hogback," which allows all of the cold air forming over the ice to drain off, never accumulating to a depth of over a thousand feet, and frequently being swept off of the ice as fast as it accumulates by strong winds aloft. Thus no "air mass" can form on Greenland as in the Lena region where accumulation to a depth of 5000 feet is possible. In summer, however, the snow-free Siberian area becomes 30° warmer than the Greenland Ice, and the former has a 118° annual range in mean monthly temperatures compared to a range of 70° for the latter.

Tropopause Height and Temperature

It is thought by many modern meteorologists that stratosphere conditions, that is, the height of the tropopause, the temperature of the tropopause and in the stratosphere, and the ozone content at high levels, has a marked effect on cyclogenesis and other troposphere conditions as well as on conditions in the stratosphere. Before any conclusions can be drawn it will be necessary to make radiation and ozone measurements in the Polar regions of both hemispheres, and to analyze such data in connection with surface weather or pressure phenomena. This is a problem of questionable immediate practical value but of tremendous potential value with the increase in Arctic and stratosphere aviation which is expected in the next decade.

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Soundings with free balloons during the past few years show that the average height of the stratosphere ranges in January from 11 km. (35,000 feet) at the 50th parallel N., down to less than 8 km. (25,000 feet) north of Hudson Bay and in Northeast Siberia. In July the range is from 12 km. (40,000 feet) at 50° N., down to 9 km. (30,000 feet) over the pack ice north of Alaska. Contrary to popular opinion, the air in the Arctic while warmer aloft (from 1000 to possibly 6000 feet) than at the surface, is colder at all levels than in the temperate zone, until the stratosphere is reached, and often well into the stratosphere. So at flying levels temperatures are quite low (40 to 70° below F. at 20,000 feet) all the year in the Arctic, and when the tropopause is low and cold, as in the spring, summer, and fall, a steep lapse rate is produced which, being unstable, precipitates out most of the water vapor which exists or is introduced into it, leaving dry air subject to excessive radiation in the low levels, and frequent anticyclogenesis.

In addition to the seasonal and latitudinal changes in the height of the tropopause, higher in the Tropics and in the summer, lower in the Polar regions and in the winter, there are nonperiodic changes which are much more marked, if more irregular and difficult to predict. For instance, at Swan Island in the West Indies the tropopause remains at about 16 or 17 km. during the entire year, since that station is nearly always in Tropical air. An occasional outburst of Polar air is so shallow as to have no effect on the tropopause, since the bulk of the air mass to a depth of 55,000 feet is tropical. This tropical tropopause is caused by uprising warm air, and the upper limit of the troposphere will always be the point at which the vertical convection ceases, even when this Tropical air invades the sub-Polar regions, as it does in western Europe.

In fact, the existence of the tropical tropopause at 15-17 km. (50,000 to 60,000 feet) with a temperature of -70° to -90° below zero C. (-94° to -120° F.) may be used to identify the existence of Tropical air aloft in Polar regions, even when, as is usually the case, there is a lower Polar tropopause at the usual height of 6 to 9 km. (20,000-30,000 feet) so that the influence of the Tropical air is not felt at the surface. This "Double Tropopause" is common from the Rocky Mountains to the Urals, and from the southern limits of the Polar Front in the vicinity of Texas and Florida to Spitzbergen and possibly as far north as the Pole on the Atlantic side. This condition either produces, or is connected with the extremely high percentage of storminess and unflyable weather which is characteristic of the North Atlantic. It is also highly probable that the area between the lower tropopause at, say, 20,000 feet and the top of the inversion where the Tropical air begins, at, say, 30,000 feet would be free from cloudiness and icing danger so that substratosphere flights in the stormy area would be highly successful if soundings were available to show this effect.

The tropical and Polar tropopauses are products of complementary thermodynamic processes which are quite important to an understanding of the Arctic air masses. As mentioned above, the tropical tropopause is associated with a warm air convection phenomena, whereas the Polar tropopause is associated with a cold air subsidence phenomena. The reader should not be confused by the fact that the temperatures in the Tropical air aloft are lower than those in the lower Polar air mass, for that apparent anomaly is due to the vast difference in height between the two masses,

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and to the usually steeper lapse rate in the Tropical air. Actually the Tropical air is at a higher potential temperature than the lower, the temperature at the Polar tropopause being 290° to 300° Absolute, while that at the tropical tropopause usually runs from 315° to 325° Absolute.

The Polar tropopause usually exists at 6 to 10 km. or 20,000 to 35,000 feet, and this altitude marks the upper limit of possible convection, cloudiness or icing in the Polar or Arctic air mass. The lowest limit of 6 km. is common in the Polar regions over an old occlusion, or over a cold anticyclone.

In summer the distinction between Polar Maritime, Polar Continental and Arctic air almost disappears due to the nearly uniform surface conditions over the Arctic and sub-Arctic. The frozen ground over the continents thaws, at least at the surface, under the influence of continual sunshine or daylight; the snow melts from the glaciers and pack ice, the ice melts from the lake areas in the Arctic, and the water area in the Polar basin increases markedly. Thus, the whole Polar area becomes one of mild, humid, semimaritime activity. Temperatures are uniformly between freezing and 50° F. Occasionally, higher temperatures occur under the influence of strong importation from the south, or of strong insolation in favored localities. Diurnal ranges, horizontal differences, and interdiurnal variabilities are slight. The latitudinal and continental influence is at a minimum. Only the effect of elevation is increased due to the greater humidity and lack of inversion, the former increasing the lapse rate and blanketing the lowlands from excessive outgoing radiation, the latter removing the anomaly, so common in the Arctic winter, of having pools of cold air in the hollows, while hill or mountain tops are 20°, 30° and even 40° warmer.

If any contrast exists in the Arctic in summer, it is between the air over the pack ice, which stays near 32° all summer, and the sub-Arctic on one side, and the warm Atlantic water on the other, where temperatures average 20° or 30° higher in July and August. (See Synoptic Northern Hemisphere Chart, September 21, 1934, figure 29.) This contrast is destroyed frequently when small, but sometimes intense, cyclonic storms invade the Polar basin temporarily displacing the Arctic Front. On the other hand, at any time during the summer a mass of mAK air can build up somewhere in the Arctic and move down over the Canadian Archipelago, or the Norwegian or Barents Sea, giving summer snowstorms and freezing temperatures, icing and fog to these parts.

In winter, that is from September to May in the Arctic, the Arctic air masses form over the Polar basin--the Continental type over the solid-pack ice north of Bering Strait, an area about half the size of the United States; and the Maritime Arctic air over the Atlantic side of the Polar basin where a larger percentage of water--warm water with respect to the amount of floe or pack ice, exists. The Continental Polar air masses come mainly from the Siberian Anticyclone, which is a northern extension of the warm central Asiatic Anticyclone, although distinctly not the warm type itself.

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Unstable Maritime Polar air masses are formed in the North Atlantic during the entire year, and the front between these masses and the Continental Polar or Arctic air from Canada, Greenland, or Scandinavia, is subject to the greatest storm activity in the Northern Hemisphere, and the worst flying weather to be found on any of the Polar routes, if not on the whole earth.

The more stable types of both Polar and Maritime air come from middle latitudes (around 45-55° N.) in North America or central Asia, the Atlantic or Pacific. Being warm-core, the masses tend to stagnate in the regions where they are formed, so the invasion of these masses into the Polar regions is rare. Whatever air of this type does exist in the Arctic or sub-Arctic comes rather by a slow process of extension of the area of the warm anticyclones from southerly regions into the higher latitudes, as in the fall or "Indian Summer" in central Canada, or Siberia. About the only type of Pacific air that is found in the Arctic, and that only rarely when a deep cyclone is centered in the Bering Sea, is mPW air from the northern extension of the Hawaiian High which pours across the high ranges of the Alaskan coast into the interior valleys. (See Synoptic Northern Hemisphere Chart, November 22, 1936, figure 31.) Occasionally, the stable Continental air drains down from the plateaus of the Rockies or of Mongolia, into the Arctic prairies of Canada or Siberia, even in December or January, for weeks at a time, giving perfect CAVU weather, with temperature perhaps 20 or 30° above normal, over a vast area, thus reversing the normal condition when midwinter is a season of little flying activity. Stable Maritime air sometimes persists for long periods along the coasts, but aviation in such cases is hampered by surface fogs or stratus, although such weather may be ideal for long distance flights if fog-free terminals are available. Tropical air aloft invades the Arctic only on rare occasions, and only in the Atlantic sector, coming from the Azores high in advance of an unusually deep low. (See Synoptic Northern Hemisphere Chart, December 16, 1936, figure 32.) Surface Tropical air would be even more rare north of 60°.

The temperature distribution in individual air masses in the Arctic tends to be more uniform than in the temperate zones but less homogeneous than the Tropical air masses. In the fall and spring with rapidly moving, or cold types of air masses, the coldest air may be just behind the front, so that the most severe cold is coincident with the most stormy weather conditions: strong gusty winds, rain, snow, or blizzards. The cold in such cases may preclude human activity even though the turbulence associated with the front keeps the temperature from dropping to fifty or sixty below as it does in stagnant air masses. Usually, if the wind is at all strong the temperature will be above 20° below although exceptions to this rule will be noted in places like Wrangel Island, where local drainage off of the continent may give temperatures of 40° below with strong winds. In the middle of the winter (December to February, incl.), on the other hand, the coldest air is to be found a day or more after the frontal passage, even in rapidly moving air masses, since turbulence in the frontal zone is about the only "warming" influence to be found in the Arctic at that season.

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In Siberia, the temperature can vary as much as 60° on the surface in the same air mass. (See Synoptic Northern Hemisphere Chart, December 18, 1936, figure 32.) This chart shows such a case where along the 60° parallel the temperature ranges from -47° at Olekminsk on the northeast side of a cA air mass, to 12° above zero at Tobolsk on the northwest corner of the same air mass but at the same pressure of 1040 mb. A distance of 1900 miles separates the two stations, giving some indication of the magnitude of such air masses. Naturally one would expect great temperature difference between two stations in the same air mass at such great distances apart, if they were oriented in a north-south direction, and such is the case in this instance; a station 1900 miles south of Olekminsk has a temperature of 28° F., or 75° warmer than the latter, while 1000 miles farther south, in the same air mass, a temperature of 65° was recorded. So, although an air mass is supposed to be horizontally homogeneous, it is possible to have wide divergence in conditions when the air mass attains continental proportions; in this case the mass was 4000 miles wide, 3000 miles across, and 6000 miles from the northeast to the southwest extremity, so it is small wonder that temperature differences would amount to as much as 112° when latitudinal, maritime and continental, and drainage conditions are taken into account. In America it is possible to have masses almost as great in extent. Several times in every decade a cP or cA mass extends from Point Barrow to Miami, a distance of 4500 miles, with temperature ranging from say 32° at Miami to -40° in Saskatchewan, and -10° at Barrow. If the mass is active--that is, moving rapidly, the latitudinal temperature gradient will be reduced, or even reversed. For instance, it may be 20° below zero in North Dakota on the front of a cAK mass, while 1500 miles to the northwest in the Peace River country the temperature would be 20° or 30° above. So also in the Arctic, the temperature over the pack ice may be 20° or 30° warmer than that over the interior of the continent, farther south, in the same air mass.

Over the close-pack region between Bering Strait and the Pole, the temperature of the cAK masses which prevail throughout the winter should be fairly constant, especially in the same air mass. From figures and maps prepared by Ficker (Ref. 37), it appears that the interdiurnal variability of temperature over the Polar basin north of Siberia is about 4° F. for the year, compared with 7° F. in the basin just east of the Urals at about 62° N. latitude.

The greatest variability is due to the frequency of passage of cold and warm waves, and that over the Arctic Ice is about the same as that over the region around the Caspian Sea. The region around the Barents Sea has the largest degree of unsteadiness of temperature of any of the Arctic regions, since it lies along the Arctic Front during the entire year. The values for the interdiurnal variability for Obdorsk at the mouth of the Ob (Ref. 37), and for the "Fram" and "Maud" expeditions (Ref. 68) are given in the following table:

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Table 7

Interdiurnal Variation in Temperature (°F.)

Station	Winter	Spring	Summer	Fall
Obdorsk	8.7°	6.0°	4.0°	4.2°
"Maud" Coastal	6.3°	4.6°	3.0°	4.5°
"Maud" Pack ice	5.4°	2.6°	1.4°	4.5°
"Fram" Pack ice	6.9°	5.1°	1.5°	5.9°

The greatest value for any month in any year was 10.0° on the "Maud" in December 1918. The summer changes seem to be much less extreme than the winter.

In the region north of Siberia where the "Maud" spent several winters, it was found that the rapidity of warming up nearly, but not quite, equalled that of the cooling off, when day to day mean temperatures were used as criteria. During the months from April to October, changes of over 10° from day to day did not occur, while along the coast there were a few instances of such changes. The following table taken from the results of the "Maud" expedition, shows the mean monthly number of days with interdiurnal temperature changes exceeding the limits given, during the years from 1922-1924 on the pack ice.

Table 8

Mean Monthly Number of Days with Specified Interdiurnal Variations in Temperature

Change	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Ann.
≥ 10°	2.0	7.0	2.0	0.5	0	0	0	0	0	1.5	6.5	3.5	23.0
≥ 15°	1.0	2.5	1.0	0	0	0	0	0	0	0	4.0	1.5	10.0
≥ 20°	0	0.5	0	0	0	0	0	0	0	0	0.5	0	1.0
≥ 25°	0	0.5	0	0	0	0	0	0	0	0	0	0	0.5

February and November show greater variability than January, due to the fact that during December and January the pack ice in this region lies entirely within the Arctic air mass, while during November and February the Arctic Front fluctuates back and forth across this region, so that the station is at times in one air mass (cAK) and at times in another (cPK), and whereas the difference between these two types of air is not as marked as the difference between cPK and mPK, for example, still there is enough difference and enough mixing along the frontal zone to cause moderate interdiurnal variability. As mentioned previously, the extreme variabilities occur in regions where masses of markedly different character oscillate over the region, or in regions of intense frontal activity. This activity increases along the Arctic coast as one goes west from Bering Strait to Novaya Zemlya.

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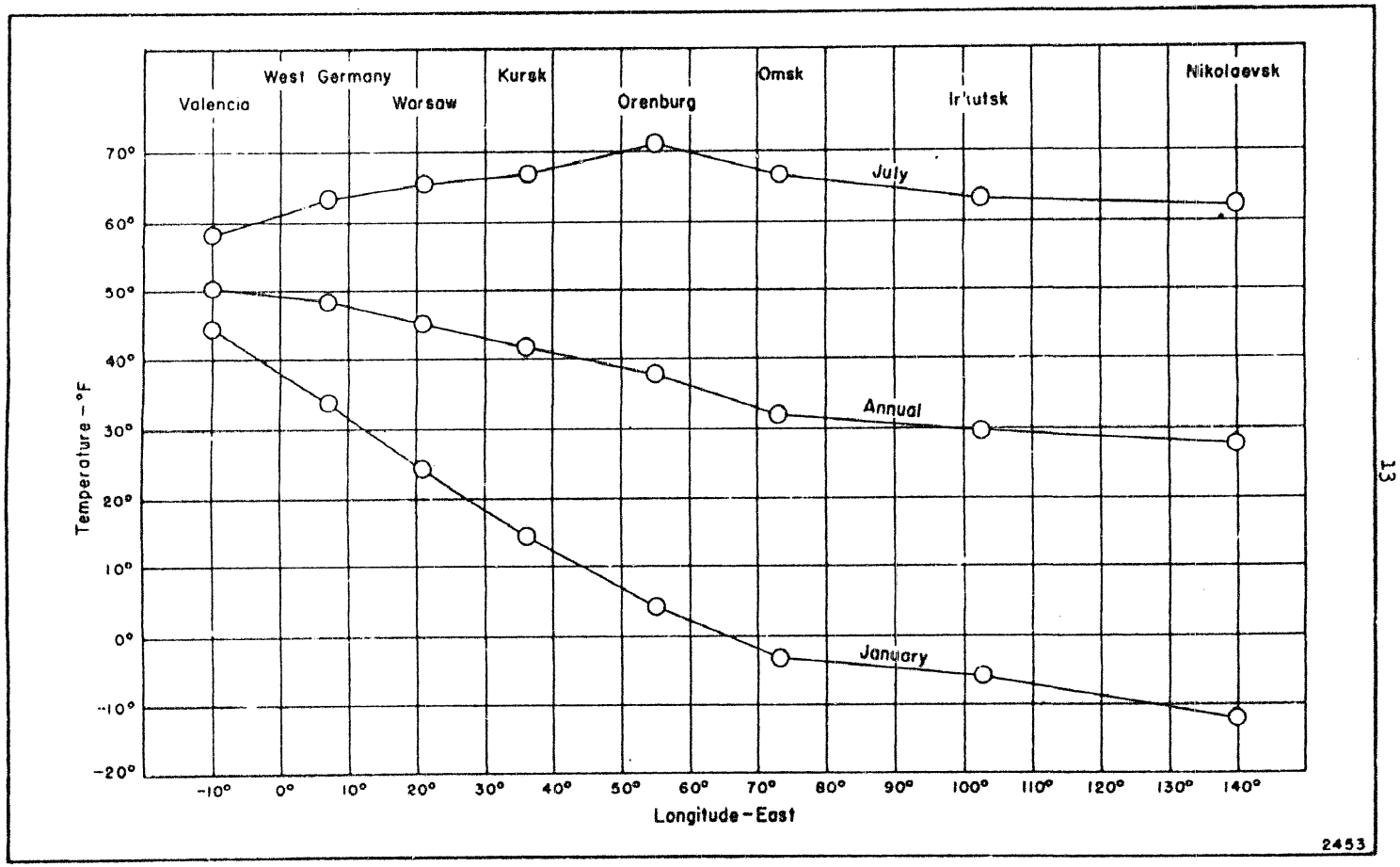

Figure 7. INFLUENCE OF CONTINENTALITY
Mean January, July and Annual Temperatures at Eurasian Stations Along the 52° Parallel

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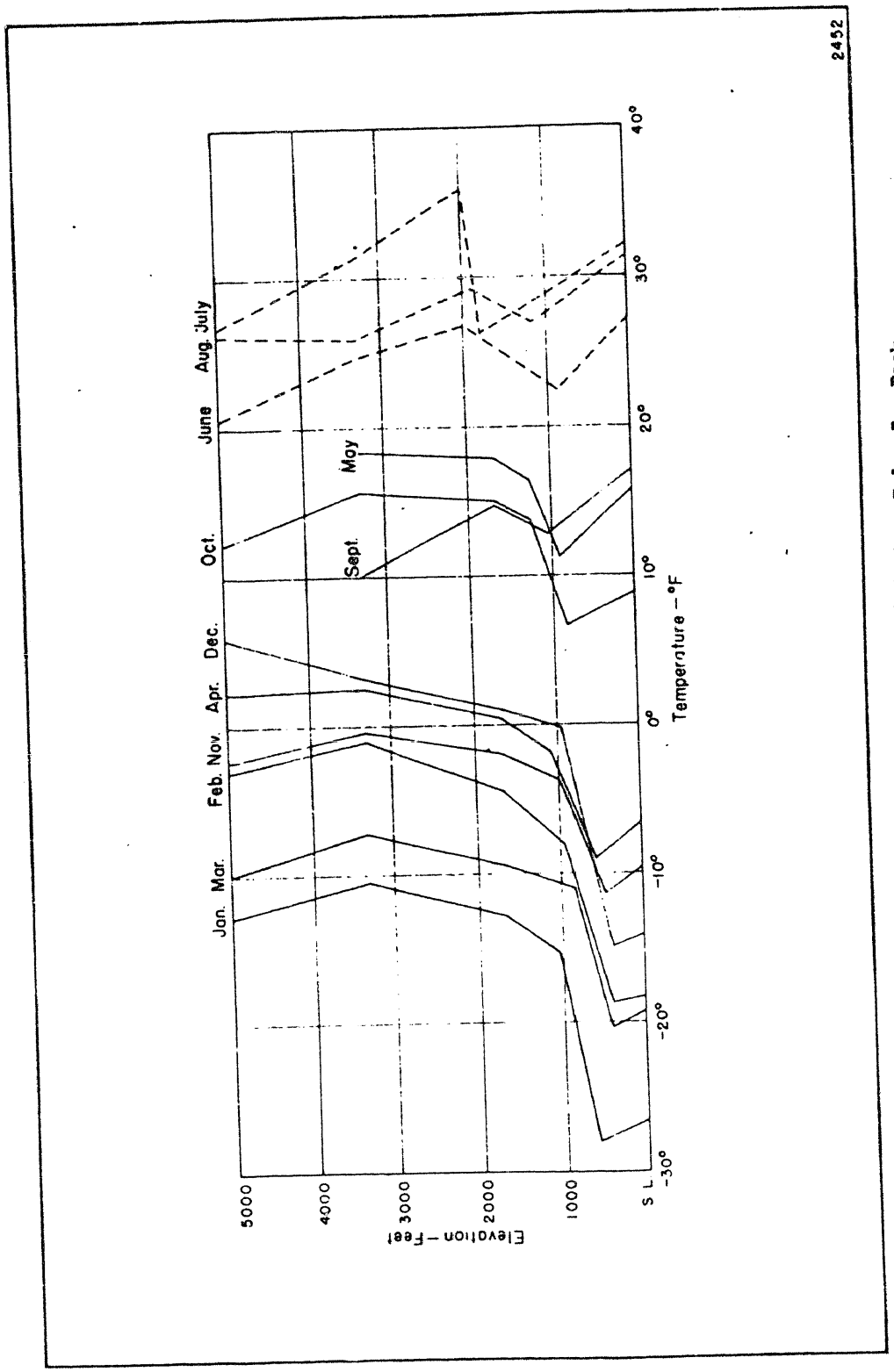

Figure 8. Mean Monthly Temperatures Aloft Over Polar Ice Pack
(From Kite Ascents -- "Maud" Expedition 1922-25)

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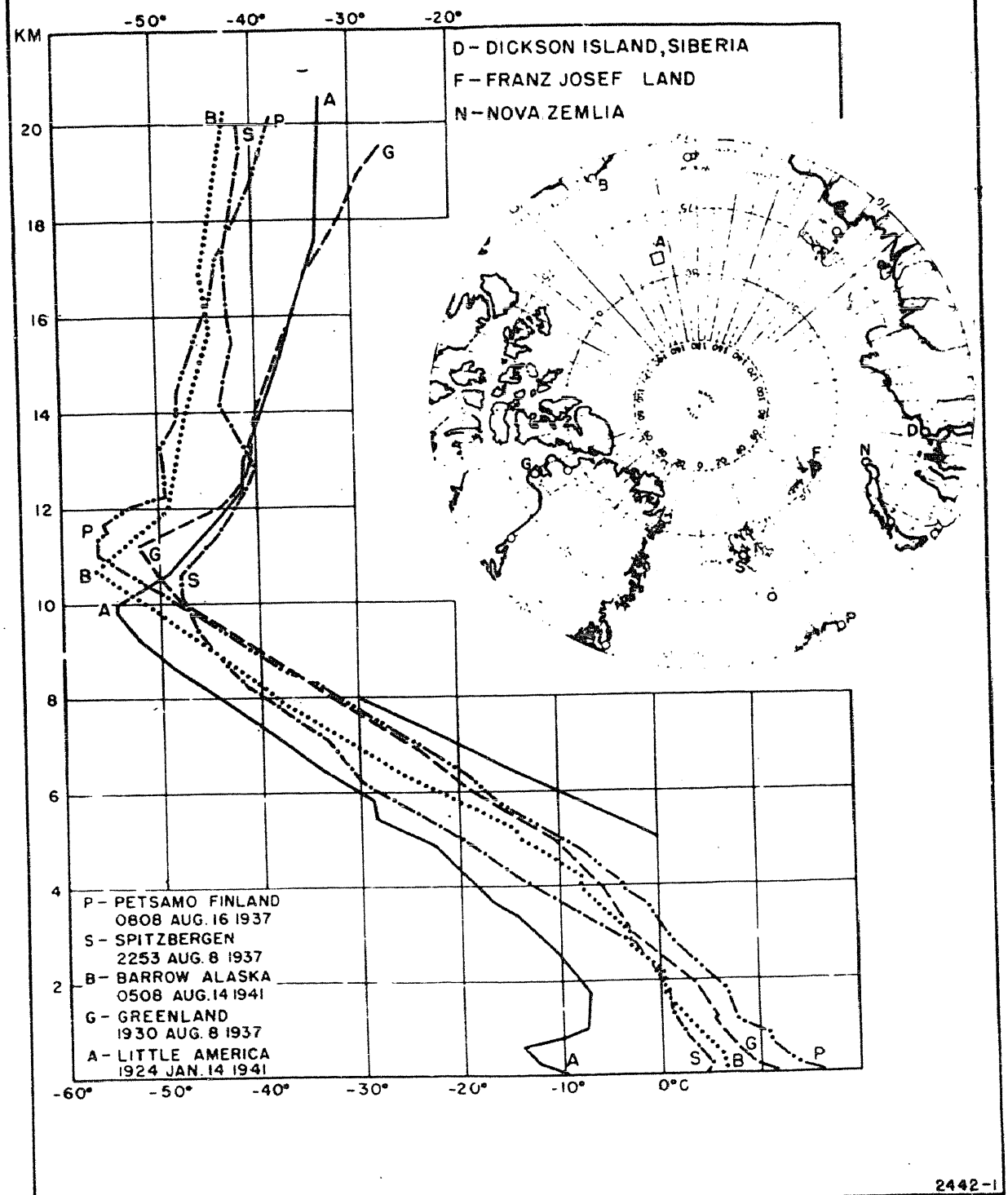

ARCTIC AIR MASSES
UPPER AIR SOUNDINGS

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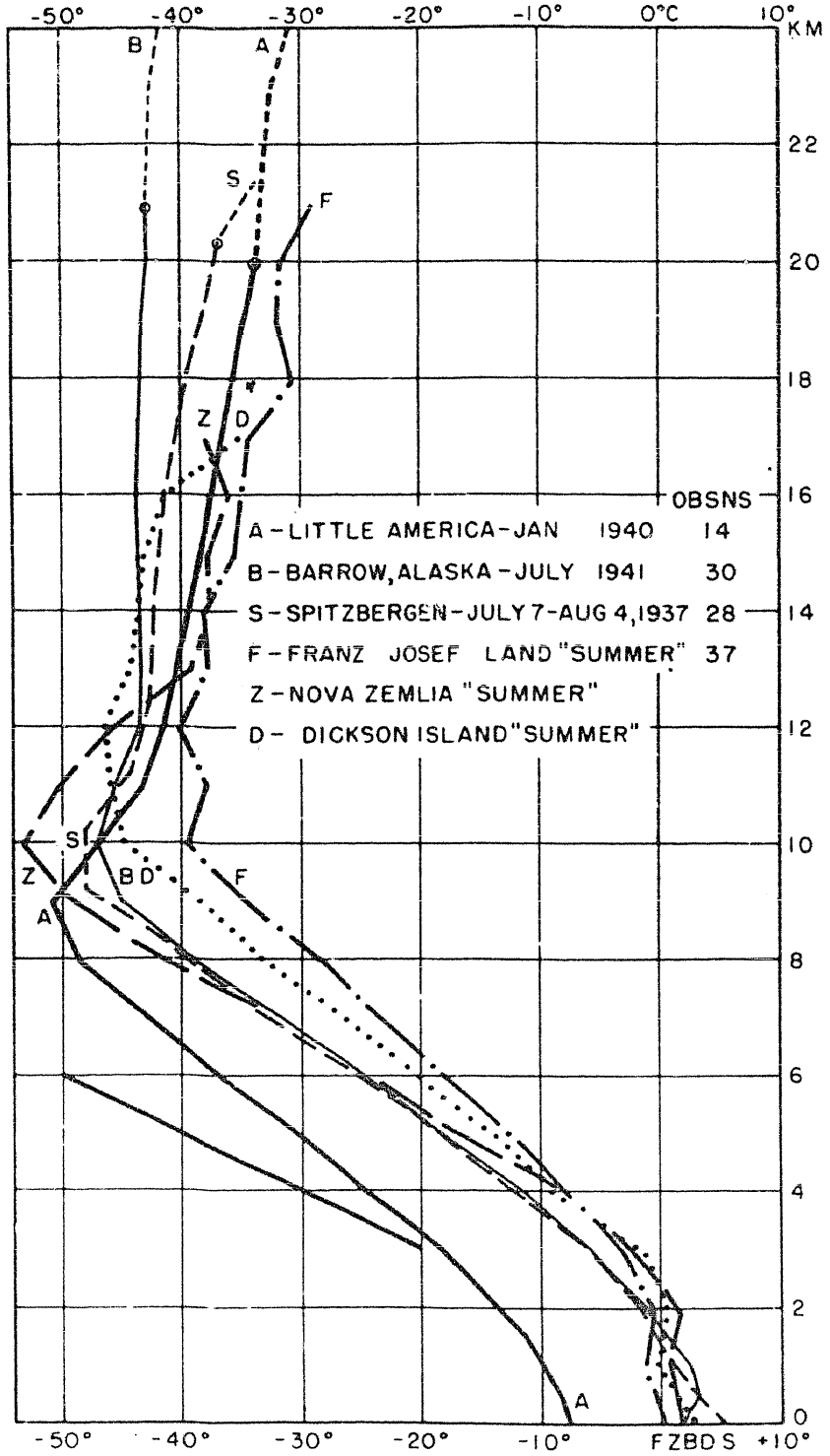

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ARCTIC AIR MASSES
UPPER AIR SOUNDINGS

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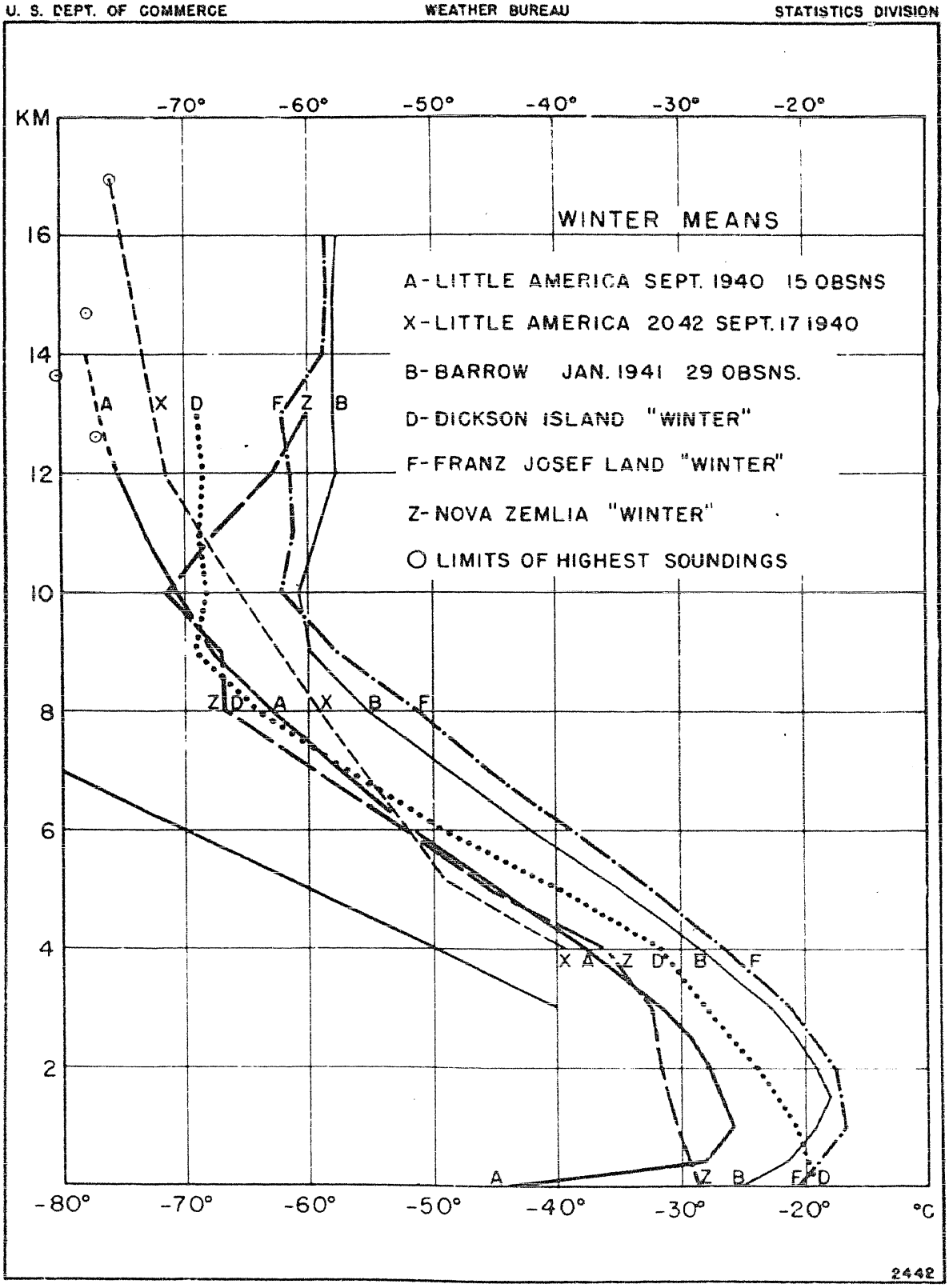

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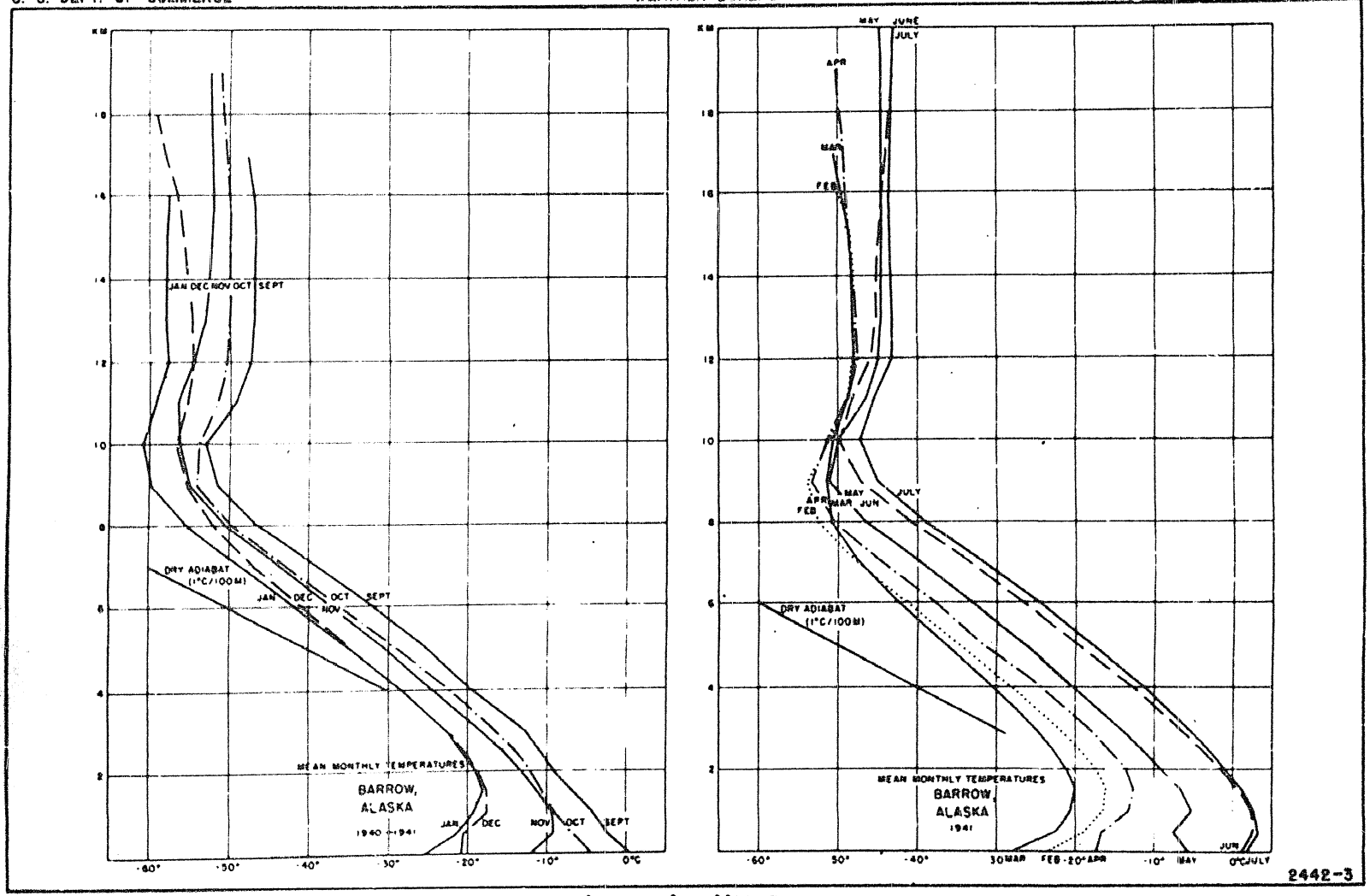

ARCTIC AIR MASSES
UPPER AIR SOUNDINGS

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Vertical Temperature Gradient

Continental Arctic air has a characteristic unstable layer in the lowest 500-1,000 feet over the ice. This is caused by the conduction of heat through the ice or by contact of the air with open water leads, even in midwinter, as can be noted from the January to March curves in figure 8. Warming from conduction through the ice, and from turbulence averages about 6° F. throughout the 500-foot surface layer, and may even be 10°-15° F. at the immediate surface. In summer when the snow is gone from the ice the warming is much greater and extends up to 1,000-2,000 feet (see June, July, and August curves in figure 8). Thus, when the normal surface temperature would be 15° or 20°, the actual surface temperature will be about 32°--the temperature of the water-ice mixture at the surface. The colder the air mass which moves over the ice, the greater the instability and the higher the unstable layer will go. It should, therefore, be expected that during seasons or periods of greater air mass movement and activity, there will be the greatest local storminess, and conversely during relatively quiet periods the weather will be more settled, the cloud tops lower, icing or fog danger at a minimum, and turbulence inconsequential. Since surface heating produces the same effect as importation of cold air aloft over a warm surface, with respect to storminess and turbulence, it is easy to see how the turbulent condition encountered in the temperate zones and the Tropics during the daytime, and the reverse condition of stability at night, does not hold in the Arctic where diurnal temperature changes are slight or reversed as they are in winter; but rather the effect is produced by the change of seasons--summer being the counterpart of afternoon in the Tropics, and winter of the early morning hours in lower latitudes.

Above the surface layer of turbulence in cAK air, there is a sharp inversion--the same inversion that is found in continental regions right at the surface. This inversion is not only characteristic, but during the winter is rarely absent. The average temperature for January, as observed on the "Maud," shows an increase of 19° F. between 600 and 3,300 feet, while between 600 and 1,100 feet there is an average increase of 13° F. Although the inversion is not so marked in other months as it is in January, it is present during every month of the year. From November to April, inclusive, the inversion is below 1,000 feet, during May, September, and October below 1,500 feet, and during June, July, and August below 2,000 feet. In every case except July, the highest temperature occurs at about 3,300 feet, above which the temperature slopes off gradually at first, then more rapidly, to the tropopause at 29,000 to 39,000 feet. During June, July, and August on the immediate coast of Siberia, or in the mAK, or mPK air in the Atlantic sector, the inversion layer may be completely lacking. In fact, it is the absence of the inversion in the Maritime air that helps to distinguish Maritime Polar or Arctic air from Continental Polar or Arctic air.

Humidity differences, of course, can be used as a method of identifying the air masses, but the relative humidity is affected materially by the presence or absence of the inversion, so the temperature and absolute humidity are the primary keys to classification. Continental Polar air may have an inversion of 40° in the first 2,000 feet, and an isothermal layer from 2,000 up to 4,000 feet, above which the temperature drops off at a normal lapse rate to the tropopause. The average January inversion

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in 1942 was about 17° from the surface to 3,000 feet at Fairbanks, while at Nome the inversion amounted to only 2° F. during the same month, due to the warming influence of the ice-covered Bering Sea.

Since the lapse rate is the best key to the stability of the atmosphere, and hence to the smoothness of turbulence of any layer in which a pilot desires to fly, there is attached table 9 which shows mean lapse rates at various Alaskan stations for a twelve-month period from September, 1941 to August, 1942. The kite observations taken on the "Maud" and shown in figure 8 depict the characteristic surface layer of turbulence, the steep inversion layer just above the surface layer and the isothermal layer above that, and hint at the steeper lapse rates above 5,000 feet. These Alaskan radiosonde data show, in addition to the surface conditions, the lapse rates up to, and a short distance into the stratosphere, or to over 40,000 feet, throughout the year. Since metric units are universal for upper-air data, these tables are given in meters above sea level, and the lapse rates in °C. per 100 meters, the standard dry adiabatic lapse rate being considered to be -1.00° C. per 100 meters, any lapse rate higher than that being considered super-adiabatic, and any positive lapse rate being an inversion. Lapse rates between -.20 and +.20 are usually considered isothermal, and these criteria are in common usage for determining the base of the stratosphere, namely that point where the lapse rate drops from a fairly steep rate to less than -.20, usually near the point where it becomes positive. In order to convert the altitudes from meters to feet, the following rough scale may be used: 1,500 m. = 5,000 feet, 3,000 m. = 10,000 feet, 5,000 m. = 16,500 feet, 9,000 m. = 30,000 feet, and 12,000 m. = 40,000 feet, every thousand meters or kilometers being equal to approximately 3,300 feet.

It should be noted in using these data that if the air is saturated, as in a cloud, a lapse rate of less than 1.00° C./100 m. will be super-adiabatic, that is, there will be violent turbulence and instability in such layers.

At Barrow, along the Arctic coast, an inversion persists at or very near the surface throughout the year, and is deep enough to affect the means up to 3,300 feet from December through June and up to 5,000 feet during March. The tropopause ranges from 25,000 feet in February and March to 35,000 feet during August. The steepest lapse rates occur at elevations which roughly parallel the tropopause and at an altitude about 8,000 feet below the tropopause: 16,000 feet in mid-winter, rising to 29,000 feet in May, 30,000 feet in August, and dropping to 16,000 feet in December. The lapse rates in these steepest layers range from -.63 in March to -.75 in August, none of the lapse rates at Barrow in any month approaching those at Fairbanks (-.96 in May) or those which exist between the inland ice of Greenland and the fjords at sea level (-1.26 between West Station and Umnak) and occasional super-adiabatic lapse rates found in mAk air, or in cAk air moving over the warm waters of the Greenland or Barents Sea during the fall. It is turbulence and icing attending these super-adiabatic lapse rates that make flying extremely hazardous in these regions where that condition exists, so it would appear that the region around Barrow was particularly favorable in this regard, there being ideal conditions there, and to the west and north over the solid pack ice throughout the year, for instrument or altitude flying due to smooth air, lack of thunderstorms, tall cumulus and turbulence-icing, although the stable air mass

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hazards of low fog, ice in fog, ice in stable clouds, monsoonal winds, and drifting snow more than spoil the advantage gained by lack of turbulence for ground operations.

Conditions at Nome are somewhat the same as those at Barrow, although the surface inversion persisting only from November to March, inclusive, is not so steep as that at Barrow (.27 at Nome, 1.12 at Barrow in January) and does not extend as high as at Barrow. Elevation of tropopause and maximum lapse-rate layers are little different than those at Barrow.

At Fairbanks, on the other hand, there is a much more pronounced and deep inversion layer in winter (November to February, inclusive) and a longer and more turbulent summer than at Nome or Barrow. The lapse rate from the surface to 500 meters attains in January a maximum of +1.66° C./100 m. compared to +1.12 at Barrow and +.27 at Nome during the same month. (Spitzbergen has a lapse rate of +1.74 in February, the highest mean inversion lapse rate found in available data, for any month.) The tropopause at Fairbanks averages about 3,000 feet higher than at Barrow, and 1,500 feet higher than at Nome throughout the year, and is about 5° F. colder at Fairbanks than at Barrow. (Tropopause temperatures in Alaska range from -50° F. to -67° F. during the year.)

The lapse rates at Barrow conform with the idea that the mean position of the Arctic Front lies to the south of Barrow during the months from September to May, inclusive, and south of Nome and Fairbanks from November to March, inclusive. During the summer, June, July, and August, the front lies north of Barrow or else is completely wiped out, while in April, May, September, and October it lies between Fairbanks or Nome and Barrow. During March of 1942 there seemed to be a southward bending of the front between Fairbanks and Nome so that Fairbanks lay to the south of the front, while Nome was in the Arctic air. A similar relation shows up between Franz Joseph Land and Spitzbergen, there being evidence that the former is in the Arctic air during May and part of June, and sometimes in October when the Spitzbergen station in practically the same latitude, but nearer the warm Atlantic waters, is south of the Arctic Front.

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Table 9

Mean Monthly Lapse Rates (°C./100 m.) at Alaskan Stations**

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
						Fairbanks (156 m.)							
Number of Observations	31	28	31	30	31	30	31	31	31	30	30	31	363
Interval Meters Sea Level													
Surface-500	+1.66	+.32	-.70	-.50	-.96	-.87	-.90	-.81	-.79	-.50	+.47	+1.10	+.09
500-1000	+.54	+.20	-.54	-.36	-.88	-.88	-.88	-.73	-.76	-.38	+.00	+.44	-.36
1000-1500	-.16	-.04	-.36	-.76	-.76	-.84	-.78	-.74	-.72	-.42	-.12	+.08	-.42
1500-2000	-.42	-.50	-.50	-.72	-.80	-.76	-.76	-.70	-.52	-.38	-.28	-.48	-.54
2000-2500	-.60	-.60	-.62	-.70	-.70	-.78	-.64	-.64	-.58	-.48	-.36	-.54	-.60
2500-3000	-.62	-.66	-.66	-.68	-.68	-.70	-.52	-.62	-.63	-.56	-.48	-.60	-.52
3000-4000	-.62	-.65	-.66	-.65	-.63	-.63	-.55	-.57	-.65	-.63	-.56	-.63	-.63
4000-5000	-.70	-.67	-.64	-.60	-.64	-.63	-.62	-.61	-.71	-.65	-.50	-.65	-.65
5000-6000	-.70	-.67	-.72	-.67	-.69	-.66	-.70	-.69	-.70	-.65	-.63	-.69	-.69
6000-7000	-.66	-.69	-.64	-.71	-.69	-.73	-.75	-.70	-.66	-.64	-.63	-.67	-.68
7000-8000	-.59	-.65	-.46	-.66	-.72	-.76	-.76	-.73	-.56	-.63	-.50	-.60	-.64
8000-9000	-.47	-.53	-.09	-.53	-.70	-.71	-.74	-.72	-.38	-.42	-.30	-.48	-.51
9000-10,000	-.22*	-.26	+.22	-.12	-.53	-.54	-.60	-.58	-.04	-.04	-.12	-.24	-.23
10,000-11,000	-.09	+.15	+.17	+.30	-.22	-.21	-.22	-.12	+.14	+.09	+.09	+.01	+.09
11,000-12,000	+.10	+.25	+.04	+.18	+.07	+.08	+.16	+.13	+.05	+.10	+.14	+.12	+.18

*Interval in which base of stratosphere occurs underlined.

**Positive lapse rates indicate inversion conditions. Negative lapse rates of 1.00 or more would be superadiabatic for dry air.
Base of stratosphere is considered to be that level where a steep negative lapse rate decreases to less than -.20°/100 m. This point is usually the same as, or within 1,000 meters of the typical stratospheric inversion.

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Table 9 (cont.)

Mean Monthly Lapse Rates (°C./100 m.) at Alaskan Stations** (cont.)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
						Nome (14 m.)							
Number of Observations	21	16	30	30	31	30	29	19	31	30	30	31	355
Interval Meters Sea Level													
Surface-500	+.27	+.10	+.20	-.38	-.42	+.14	-.38	-.40	-.54	-.66	-.06	+.20	-.26
500-1000	-.14	+.04	+.02	-.40	-.32	-.64	-.42	-.62	-.76	-.52	-.54	-.12	-.34
1000-1500	-.28	-.10	-.22	-.56	-.42	-.54	-.42	-.54	-.72	-.50	-.40	-.40	-.40
1500-2000	-.48	-.40	-.46	-.53	-.44	-.64	-.38	-.52	-.52	-.50	-.30	-.54	-.46
2000-2500	-.60	-.52	-.48	-.60	-.58	-.56	-.42	-.54	-.52	-.56	-.48	-.54	-.54
2500-3000	-.60	-.58	-.52	-.64	-.54	-.58	-.42	-.54	-.58	-.54	-.50	-.66	-.56
3000-4000	-.66	-.62	-.61	-.63	-.56	-.62	-.51	-.55	-.63	-.59	-.57	-.65	-.60
4000-5000	-.63	-.64	-.63	-.61	-.58	-.65	-.62	-.63	-.65	-.59	-.59	-.65	-.63
5000-6000	-.65	-.66	-.63	-.67	-.64	-.65	-.68	-.66	-.71	-.66	-.65	-.66	-.69
6000-7000	-.63	-.70	-.58	-.68	-.67	-.70	-.71	-.68	-.70	-.63	-.62	-.60	-.66
7000-8000	-.57	-.66	-.47	-.60	-.63	-.74	-.65	-.72	-.66	-.58	-.54	-.53	-.61
8000-9000	-.36	-.46	-.19	-.27	-.53	-.65	-.60	-.72	-.56	-.41	-.35	-.34	-.45
9000-10,000	+.00	+.19	+.00	+.08	-.26	-.30	-.40	-.55	-.38	-.10	-.13	-.08	-.17
10,000-11,000	+.08	+.42	+.04	+.23	+.06	+.02	-.25	-.08	-.04	+.12	-.07	+.18	+.06
11,000-12,000	+.19	+.23	+.18	+.13	+.15	+.15	-.03	+.28	+.16	+.10	+.10	+.14	+.13
12,000-13,000							+.09						

**Positive lapse rates indicate inversion conditions. Negative lapse rates of 1.00 or more would be superadiabatic for dry air.
Base of stratosphere is considered to be that level where a steep negative lapse rate decreases to less than -.20°/100 m. This point is usually the same as, or within 1,000 meters of the typical stratospheric inversion.

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Table 9 (cont.)

Mean Monthly Lapse Rates (°C./100 m.) at Alaskan Stations** (cont.)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
						Barrow (6 m.)							
Number of Observations	31	28	30	30	31	30	31	31	31	31	30	30	365
Interval Meters Sea Level													
Surface-500	+1.12	+.82	+.80	+.58	-.28	+.32	+.20	+.32	+.04	+.30	+.86	+.70	+.10
500-1000	+.32	+.52	+.64	+.30	+.24	+.24	-.26	-.10	-.12	-.04	-.06	+.10	-.40
1000-1500	-.10	-.16	+.04	-.13	-.08	-.32	-.48	-.32	-.28	-.32	-.28	-.12	-.48
1500-2000	-.32	-.28	-.18	-.36	-.36	-.44	-.42	-.40	-.36	-.54	-.44	-.32	-.56
2000-2500	-.46	-.38	-.38	-.50	-.46	-.54	-.42	-.44	-.44	-.50	-.52	-.48	-.54
2500-3000	-.52	-.50	-.40	-.56	-.54	-.62	-.48	-.54	-.52	-.52	-.46	-.56	-.58
3000-4000	-.59	-.55	-.58	-.59	-.55	-.59	-.51	-.56	-.59	-.56	-.55	-.64	-.60
4000-5000	-.65	-.58	-.63	-.59	-.58	-.62	-.61	-.61	-.66	-.58	-.63	-.69	-.64
5000-6000	-.65	-.64	-.61	-.67	-.65	-.65	-.65	-.66	-.71	-.68	-.66	-.67	-.67
6000-7000	-.63	-.52	-.56	-.69	-.68	-.72	-.69	-.69	-.72	-.70	-.61	-.62	-.66
7000-8000	-.52	-.39	-.42	-.64	-.70	-.74	-.74	-.75	-.72	-.61	-.47	-.48	-.63
8000-9000	-.30	-.14	-.04	-.34	-.48	-.63	-.71	-.74	-.66	-.44	-.23	-.20	-.46
9000-10,000	-.12	+.12	+.22	+.07	-.08	-.37	-.46	-.65	-.46	+.04	+.07	-.02	-.19
10,000-11,000	-.04	+.21	+.17	+.24	+.16	-.06	-.09	-.14	+.05	+.25	+.16	+.11	+.05
11,000-12,000	-.01	+.15	+.08	+.15	+.21	+.19	+.17	+.22	+.21	+.07	+.12	+.07	+.14
12,000-13,000	+.11	+.06	+.03	+.01	+.04	+.17	+.16	+.17	+.13	+.00	+.04	-.03	+.09

**Positive lapse rates indicate inversion conditions. Negative lapse rates of 1.00 or more would be superadiabatic for dry air.
Base of stratosphere is considered to be that level where a steep negative lapse rate decreases to less than -.20°/100 m. This point is usually the same as, or within 1,000 meters of the typical stratospheric inversion.

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Table 10

Vertical Temperature Gradient (°C./100 m.) Surface to 500 Meters*

Station	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Ellamitte*	-1.20	-1.12	-.82	-.72	-.76	-.79	-.67	-.84	-.90	-1.08	-1.22	-.92	-.92
West Station*	-1.00	-1.03	-.49	-.56	-.45	-.60	-.79	-.77	-.85	-1.10	-1.26	-1.15	-.84
Spitzbergen	1.50	1.74	.32	.18	-.70	-.66	-.70	-.44	-.70	-.68	.54	.96	.02
Barrow	1.12	.82	.80	.58	-.28	.32	.20	.32	.04	.38	.86	.70	.10
Nome	.27	.10	-.20	-.38	-.42	-.14	-.38	-.40	-.54	-.66	-.06	.20	-.26
Fairbanks	1.66	.32	-.70	-.50	-.96	-.87	-.90	-.81	-.79	-.50	.47	1.10	.09

Note: All values without minus sign are positive (inversion).
*Lapse rates for these stations are obtained from mean temperature on the ice at station given, compared to mean temperature of stations at a lower elevation (West Station and Umiak, respectively) and represent a layer of greater depth than that at the other stations in this table.

Table 11

Mean Height of Tropopause in Kilometers

Station	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Barrow	9.0	8.0	8.0	9.0	9.5	10.0	10.3	10.5	10.3	9.5	9.2	9.0	9.4
Nome	9.0	8.7	8.0	8.6	10.0	10.2	11.0	10.5	10.3	9.5	9.3	9.2	9.5
Fairbanks	10.0	9.6	8.5	9.5	10.3	11.0	11.4	10.5	9.5	9.3	9.2	10.0	10.0
Toronto	10.3	9.7	9.9	10.8	11.7	12.8	13.8	14.0	13.9	13.6	12.6	11.3	12.0
Franz Joseph Land	8.1	8.0	8.1	8.8	7.9	9.4	10.0	10.3	8.9	10.7	9.9	8.9	9.1
Batavia	17.5	17.6	17.2	17.0	17.0	16.4	16.0	16.5	17.0	17.3	17.2	17.1	17.0

Note: These values are obtained from only a one-year record in most cases.

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Summer Air Masses in Lapland

Kuttner (Ref. 43) has made a very thorough study of air masses affecting Lapland during the International Polar Year (1932-33) when a great many soundings and airplane ascents were made in the Arctic. For simplification he has divided the air masses which cross Lapland into three types:

1. Arctic
2. Maritime
3. Continental

Arctic air in that region would include mAk air from northwest of Spitzbergen, as well as cAk air from northeast of Spitzbergen, since those mAk masses would come across the ice which covers that region in the spring and early summer. Any mAk air from southwest of Spitzbergen would be included in the second category as Maritime air, along with the mPk and mPw air from the North Atlantic and North Sea. In the third category, under Continental air would be included cPw air during the summer season, with winds mostly from the southwest and southeast. During the period from May 1 to September 15, 1933, a period of 138 days, the following distribution of air masses was found over Lapland:

Arctic air masses: 75 days: 54%
Maritime air masses: 55 days: 40%
Continental air masses: 8 days: 6%

The Continental air was limited to the months of June and July and as mentioned previously, is not very different from Maritime air in summer. The percentage distribution of the three air masses during the 4 1/2 months of this study is as follows:

Table 12

Distribution of Air Masses over Lapland in Summer

Month	Arctic	Maritime	Continental
May 1933	81	19	0
June "	63	24	13
July "	16	71	13
August "	48	52	0
Sept. "*	73	27	0

*September 1-15.

On 41% of the days air masses came to rest over Lapland, thus being modified to cAw air masses before moving over Russia or southwest Europe. In these latitudes Tropical air masses are rare, reaching the ground only twice during the summer of 1933. On June 7 cTw (the equivalent of Superior air in North America) came in aloft, and by June 10 had introduced enough mTw air so that marked surface warming took place on that date. A warming at 6,600 feet of 18° and at 10,000 feet of 27° took place in one day. The highest temperature of the summer came during the period from July 7 to 10, when another dry cTw air mass preceded surface mTw air.

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The temperature in southern Finland reached 91.4° F. and in Polar Lapland at Sodankyla on the 10th of July the temperature reached 86° F. The same situation exists in Alaska and northwest Canada with respect to high summer temperatures, except that actual mTw air does not reach the surface in the American Arctic, but rather modified mPw or mPw mixed with S (central Canada).

During the summer very steep temperature gradients are the rule: at 9 a.m. lapse rates close to the dry adiabatic are common, and at 3 p.m. are almost universal. The woods in all of Lapland are very sparse, most of the ground being covered with dry reindeer moss. Above 1,200 feet m.s.l. vegetation of any kind is rare or absent. Therefore, the already steep lapse rates of Maritime air masses (except tropical) are greatly increased by the rapid surface warming which follows the short clear summer nights of the Arctic and sub-Arctic continent. The continental type of Arctic air, likewise, is made very unstable when it passes off of the icy seas onto the relatively hot barren lands of Lapland.

During the summer in this region the humidity in Arctic air masses, both relative and absolute, is very low compared to that in summer masses over the swampy regions of Siberia and Arctic America. Vapor pressure in Lapland in May is 3-4 mb., in July 7-10 mb., and in September 5-7 mb. at the surface. As a result, visibility is excellent (up to 120 miles) and the condensation level is remarkably high: in May in spite of low surface temperatures it averages 6,000 feet (cumulus clouds) at 9 a.m., 7,500 feet at 3 p.m. The temperature gradient up to this altitude is nearly dry adiabatic. Thus, a characteristic feature of Arctic air masses over Lapland is a nearly dry adiabatic lapse rate up to 6,000 feet.

Maritime air usually invades Lapland from the southwest, coming across the high ranges of Norway. As a result there is a marked foehn influence on temperature, cloudiness, visibility, and humidity. The visibility, however, is not as good as in Arctic air, and the relative and absolute humidity is higher. Ceilings, therefore, are lower, in spite of the higher temperatures, than in Arctic masses, the cloud base in July usually lying between 3,500 feet and 5,000 feet. Surface vapor pressure in July averages from 10 to 13 mb. in Maritime air masses. Lapse rates below the condensation level are more stable than in Arctic air, but due to the greater specific humidity and lower condensation level there is a deeper layer of moist adiabatic lapse rate aloft, resulting in thicker and more persistent cumulus cloudiness in Maritime than in Arctic air. This deep, unstable, enduring, cloud layer is characteristic of mP air which has crossed high ranges into low Arctic valleys or plains such as are found in Lapland and Alaska.

It should be remembered, however, that air coming from the Gulf of Alaska into the interior valleys must cross ranges running from 8,000 to 15,000 feet with single peaks 18,000-20,000 feet high, whereas the ranges of Norway run from 4,000-6,000 feet above sea level, with single peaks of 8,000 feet. Thus, air masses coming across the Alaska range into Alaska and Yukon will be more affected by the foehn influence, the cloud bases will be higher, visibility better and lapse rates not so steep as in similar air masses entering Lapland. mP air can, however, enter the Yukon Valley from the Aleutians without crossing any high mountains, in which

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case the specific humidity will be higher, lapse rates in the cloud layer steeper, the condensation level lower and visibility poorer than in Lapland. This last occurrence, although rare, coming only once or twice in a decade, is very persistent and completely reverses the normal flying conditions of the summer season, bringing a week or two of closed or instrument weather over large areas, followed by a period of intense thunderstorm activity with hail, severe icing, cloudbursts and floods, adding to the normal turbulence and lightning hazard of thundery weather.

As previously mentioned, the advent of Continental air is rare in Lapland, but when it does occur it gives characteristic conditions over a large area. Stable lapse rates, low relative humidity, high surface and upper air temperatures, and poor visibility prevail during these periods. In America the same conditions, accompanied by a widespread area of forest-fire smoke which reduces visibility even up to 20,000 feet and makes flying and photography difficult or impossible, may prevail for periods of from 2 days to 2 weeks when warm Continental air invades the sub-Arctic.

Cumulus cloudiness is found during an unusual high percentage of the time in the Scandinavian and Finnish Arctic. In 1933 this type of cloud was observed on 75% of the days in summer. The percentage by months was as follows:

	May	June	July	Aug.	Sept.	Average
Cumulus Cloudiness	65%	80%	90%	80%	60%	75%

According to flyers in this region, such turbulent conditions are characteristic of the continental Arctic summer, and this high percentage of turbulence under the cloud layer is important for flying photographic or ambulance planes, especially since "moderate" or "severe" turbulence is reported by flyers on 22% of the days in that period. Updrafts of 17, 13, 15, and 11 m.p.h. were calculated at 3,000 feet above sea level on four occasions when strong super-adiabatic lapse rates existed under the cloud layer in cAk air masses. The highest velocity of updraft below the cloud base was 20 m.p.h. at 4,500 feet and in the clouds 25 m.p.h. at 7,500 feet.

It has been mentioned that lack of sunshine in the Arctic in winter practically eliminates convective instability in continental areas, including those areas of the Polar Sea which are continent-like due to closely packed ice. The converse is likewise true--that during the longer hours of sunshine in the summer the duration of convective activity would be greatly increased. Cumulus activity lasting for 15 hours, from 6 a.m. to 9 p.m., was often observed at Sodankyla, Finland (latitude 69°) in June. The average length of cumulus activity at that station in June was 13 1/2 hours, while in early September it had decreased to 10 hours and 40 minutes. At Kemijarvi, which lies just north of the Arctic Circle in Finland, 60% of the observations taken between May and August, inclusive, showed convection cumulus beginning before 9 a.m. and 18% before 7 a.m., while 25% of the time convection continued until after 9 p.m., and at Sodankyla 34% of the time showed such action after 8 p.m. Farther north convection would last even longer in summer.

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Table 13 shows the average monthly and latitudinal variation in diurnal convective duration as taken from observed cumulus activity, length of time the surface mean temperature is above the mean for the day, etc. Values are approximate and would vary in the same latitude with distance from bodies of water, altitude, surface cover, etc.

Table 13

Average Number of Consecutive Hours of Convective Cumulus Growth per Day

Lat.	Sta.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Yr.	Summer
35°	Amarillo	3	4⅓	6	7	8	8½	8	7½	7	6	3½	2½	6.0	8
46°	Ellendale	2½	3½	5	7⅓	8½	9⅓	9	8⅓	7⅓	5½	3½	2	6.0	9
54°	Edmonton	1½	3	4½	8	9½	10½	10	9	7⅓	5	3	1	6.0	10
67°	Kemijarvi	0	1	3⅓	8½	11	12½	12	11	8	4	2	0	6.1	12
68°	Sodankyla	0	1	3	9	12	13½	13	11½	8	3	1	0	6.2	12
70°	Petsamo	0	⅓	3	9½	13	14½	14	12	8	2	½	0	6.4	13

It will be seen that, although the annual values increase very slightly as you go north, the values for the summer months of May, June, July, and August increase considerably and those for June and July the most. If values were entered for hours and minutes, some of the irregularities would be smoothed out, which are due to reduction to the nearest half hour.

From the above data it can be seen that a surface inversion would be expected in Lapland between 9 p.m. and 7 a.m. in June and July, for longer hours earlier in spring or later in the fall, and for practically all of the time from November to February, inclusive. This is actually the case. Although the soundings made at 9 a.m. do not show this inversion in summer except occasionally in May, August, and September, and the 3 p.m. flights show adiabatic or super-adiabatic lapse rates most of the time in the surface layers, the data for Lapland show that at about 9 p.m. inversion sets in amounting to as much as 5 or 6° F. in the lowest 500 feet or so. This is not as marked an inversion as one finds in lower latitudes where the temperature may drop from 95° to 55° in a mountain valley without change of air mass, or much change in temperature at 1,000 feet above the surface.

The longer hours of sunshine, uninterrupted in Lapland during June and July, or 50% longer than at 50° N., keep the surface temperatures higher in the early morning hours, while the lower altitude of the sun, 20° lower than, say, in Montana, cuts down the normal daytime insolation, both effects reducing the magnitude and depth of the inversion layer. So at the same season an air mass could have an inversion of 6° over the plains of Lapland, and 18° over the plains of North Dakota, while in the mountains of northern Sweden an inversion of 15° would correspond to one of 45° in a valley similarly situated in the mountains of northern Idaho. This applies only to summer cAw and cPw air masses.

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It might be expected that since the inversions are slight, the warming of air masses coming from the ocean would also be slight, or would extend to a limited height. However, charts showing the depth of the continental warming indicate that this warming is considerable, extending to as high as 10,000 feet, and that even at 6,000 feet the warming is as great as at the surface providing the upper inversion is not below that level. In one case in mA air (June 12-13, 1933) a surface rise of 13° was accompanied by an equal rise in temperature at 5,000 feet, and due to the resulting lowering of humidity, an accompanying rise in the condensation level of nearly 1,000 feet, all in 24 hours without change in air mass.

On the 15th of June, 1933, a warming of 9° throughout the entire layer from the surface to 4,000 feet completely wiped out a powerful inversion, allowing instability and cloud to build up to 10,000 feet where otherwise the cloud top would have been at 4,000 feet if clouds formed, and at the same time allowing the surface temperature to rise several degrees higher than would be expected from the shape of the sounding. This type of occurrence is more common than is often suspected, and is the reason for frequent miscalculations in surface temperature, cloud height or thickness, or thunderstorm formation when soundings alone are used as a guide to such forecasts.

The peculiar thermal effects of the continental areas of the Arctic are important, not only in forecasting cloud heights and thunderstorms, surface temperatures and icing levels, but for anticipating the possibility of difficulties due to turbulence: in winter slight or no turbulence; in summer considerable and persistent turbulence. One advantage of this long duration of turbulence in the Arctic summer would be for glider planes: it would be possible for gliders to stay aloft for 15 hours in Lapland or Alaska whereas they could stay aloft for only 6 or 8 hours in the United States in similar topographical locations. The turbulence, while marked, is not severe enough in most instances to wreck planes of this type, providing Cu-Nb clouds are avoided.

Movement of Arctic Anticyclones

There is one distinct "trough" or path for the movement of Arctic air masses from the Polar basin into the Western Hemisphere, and that is the east slope of the Cordillera, or specifically the Mackenzie basin. During most of the winter months a continual procession of cAk, or possibly cPk air which has crossed the region north of Alaska from northeastern Siberia, moves across the coast line between Aklavik and Coppermine and pours across the Canadian prairies toward Montana, Dakota, or the Lakes region. These movements are attended by great fluctuations in temperature and weather conditions, except during periods when a continual flow of Arctic air pours from the region north of Aklavik down the trough to middle latitudes, sometimes for two or three weeks without a break.

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In the Eurasian sector there are three main paths for the invasion of Arctic air to lower latitudes. The mAk air from the region northeast of Greenland crosses the Norwegian Sea to the Scandinavian Peninsula and thence into central Siberia. This unstable air gives snow and storm to the whole northern European area during spring and fall, and bitter weather during the winter. Another trough for mAk air is the Barents Sea coast from Murmansk to Cape Dickson, across the Urals to central Siberia. In January and February these masses move straight south across the Steppes of Russia to the Black-Caspian Sea region. During the other seasons the stream of cold air turns east and moves toward the Lake Baikal region. The third type of invasion is that of cAk air from the pack-ice north of the New Siberian Islands, south across the northeastern Peninsula of Siberia into the Bering Sea or Sea of Okhotsk. This is the coldest and most stable air. It produces continual blizzards at low levels along the Arctic coast but more favorable weather in the interior, except in the warmer seasons, when it brings widespread fog and drizzle to interior Siberia.

Humidity of Arctic Air Masses

In speaking of humidity, it is essential to distinguish between specific humidity, absolute humidity, and relative humidity. The absolute humidity, or actual amount of moisture in the air, may be expressed in terms of grains per cubic foot, and the specific humidity in grams per kilogram of air. Another method of humidity measurement is in terms of the pressure that the water vapor exerts on a column of mercury, and the units in which this quantity is expressed are: inches, millimeters, or the more common dynamic unit which corresponds to the units on current weather maps--millibars. The vapor pressure is not synonymous with specific humidity as the relation between the two functions is not strictly linear, even at sea level, but varies with the pressure. Since the formula for converting vapor pressure in millibars to specific humidity in g/kg is:

$$\text{specific humidity} = \frac{622 \times \text{vapor pressure (mb.)}}{\text{pressure (mb.)}}$$

then the specific humidity will vary from the vapor pressure inversely with the pressure. Hence, if the vapor pressure at a station were used as an indicator of the specific humidity at the same station in two different seasons when the pressure was the same, the substitution would be justified, but if the pressure had gone up from, say, 1,000 mb. to 1,050 mb. in the meantime, then the vapor pressure would indicate the moisture content only within an approximate accuracy of 5%, which, however, is within the range of observational, instrumental, and other errors which enter into the calculation of mean vapor pressures. So it would be safe to use the vapor pressure, in the absence of other moisture data, for the calculation of humidity relationships between seasons at the same station, or between stations, providing there is not too much difference in elevation between these stations. It should be noted, however, that if the stations differ in elevation by 10,000 feet, such calculations might be as much as 35% off.

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Relative humidity, on the other hand, is merely the ratio between the actual vapor pressure of a small quantity of air and the saturation vapor pressure of that air at the same temperature. Or it may be the ratio between the specific or absolute humidity of a quantity of air and the specific or absolute humidity of the same mass or volume of air at the same temperature when just saturated. This ratio, as will be shown below, varies greatly with reasonably small changes in temperature, so that, for instance, warming a small volume of air from 32° to 50° F. will double the capacity of the air for water vapor, thus approximately cutting the relative humidity in half.

Thus, it is apparent that vapor pressure is a much better indicator of actual moisture content than relative humidity, and since there are a great deal of vapor pressure data, and almost no available specific humidity data for the Polar regions, tables showing the vapor pressure will be used as roughly representative of moisture conditions, rather than risk introducing further inaccuracy into the data by attempting to convert the vapor pressure to specific humidity without the necessary pressure data.

Tables of mean relative humidity will be given later since they are of some significance if properly interpreted.

From table 14 it can be seen that in the summer at Coppermine, on the fringe of the Arctic Ocean, there is actually less moisture in the air when the humidity is 78% than there is at Yuma, Arizona, on the desert, at noon in June with a relative humidity of 18%, due, of course, to the fact that the air at 100° F. can hold six times as much moisture as it can at 46°:

Table 14

Vapor Pressure (mb.) for Various Types of Air Masses

Station	Air Mass	Month	Mean Temp.	Sat.v.p.	RH(%)	Act.v.p.(mb.)
Batavia	mEK	Feb.	80.2	34.54	85	29.12
Key West	mTK	July	84.4	39.96	77	30.80
Key West	mTW	Feb.	66.8	22.35	80	17.95
Yuma, Ariz.	mPW (or S)	June*	100.2	65.02	18	10.84
Jan Mayen	mAK	July	40.5	8.47	90	8.00
Jan Mayen	mPK	Feb.	21.9	3.83	83	3.18
Coppermine	mPK (cPK)	July	46.4	10.70	78	8.33
Coppermine	cAK	Feb.	-25.8	.42	73	.31

*Noon data.

It is also to be noted that although the relative humidities are nearly the same, the amount of moisture in the air in February at Coppermine is only 1.7% of that in the maritime air at Key West during the same month, and 1.0% of that at Key West in the summer. In the summer, on the other hand, the Coppermine data shows 27% as much moisture as Key West, indicating that it has become more nearly maritime in character, due to the fact that the whole Arctic region is water covered or water soaked in summer.

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Jan Mayen, on the other hand, shows a maritime condition even in February, the vapor pressure being 10 times that at Coppermine, which is 5° farther toward the Equator, and this is borne out by the fact that the pack ice does not usually close in around Jan Mayen until March or April. It may also be noted that differences are greater between different types of air in the Arctic than in tropical or equatorial regions.

In view of the above representations, it would appear that a table showing a few representative monthly values of surface vapor pressures would be more valuable than a large amount of relative humidity statistics, except where fog formation is to be considered. The data obtained on the "Maud" expedition in table 15, while limited in scope, will be of some value in respect to conditions in the East Siberian Sea.

Table 15

Monthly Mean Vapor Pressures (mb.)

Station	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Ann.
Coppermine	0.45	0.31	0.48	1.01	3.52	5.98	8.33	10.80	6.54	2.56	0.70	0.57	3.44
Chesterfield	0.41	0.38	0.72	1.66	3.10	5.69	9.25	9.85	7.52	3.99	1.42	0.55	3.88
Jan Mayen	4.36	3.18	4.00	4.27	5.20	6.40	8.00	7.73	6.40	5.33	4.40	4.13	5.20
Foka Bay	___	1.56	1.73	2.22	2.76	5.00	5.69	6.32	4.36	2.12	2.48	2.25	3.32
Goose Fjord	0.28	0.63	0.41	0.87	2.35	5.28	6.41	5.81	2.96	1.36	0.64	0.47	2.29
Ayan Island	___	___	___	1.75	3.22	6.50	___	___	___	2.53	1.40	___	___
"Maud" Pack-Ice	___	___	___	___	2.05	5.19	5.86	6.01	4.05	1.76	___	___	___
C. Serdze-Kamen	___	___	1.42	2.08	4.56	___	___	___	5.55	3.95	2.13	___	___
Sagastyr	0.27	0.27	0.27	1.07	2.90	5.87	8.13	7.20	5.87	2.00	0.67	0.40	2.93

The outstanding feature of this table is the regularity with which the minimum values fall in February and the maximum in August. Jan Mayen, and Goose Fjord (south Ellesmere Land) show maxima in July, and Goose Fjord a minimum in January. It is also quite plain that even Foka Bay (Novaya Zemlya), which is well to the northeast and in "Fast-ice," shows a tendency toward the maritime influence which is so marked at Jan Mayen, which lies in more open waters and nearer to the Gulf Stream.

In mPK or mAK air masses, such as are found over the Atlantic section of the Arctic, and over the entire Arctic in summer, the air is near saturation at the surface if over water, and usually above saturation at the surface if over ice. Due to the steep lapse rate which is characteristic of mAK air, saturation continues as high as convection but the actual moisture content rapidly diminishes due to the rapid falling off of temperature and the consequent smaller capacity of the air for moisture. For instance, at 16,000 feet the amount of moisture in the air would be about .1 g/kg in cAK air, .4 g/kg in mPK air, .7 in mPW, and 2.3 in mT air, although the surface values were 3.0, 3.9, 2.6, and 13.3 g/kg, respectively.

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Compared with lower latitudes, the relative humidities over the entire Arctic will be found to be high--generally between 75% and 100% at all seasons, even over the continental areas, except where foehn effects are persistent. In fact over the glaciers and pack ice it will be found that relative humidities with respect to ice are frequently well above 100%. Examples of this supersaturation, according to Malmgren (Ref. 48) are given for observations taken on the polar ice on the "Maud" expedition, in the following table:

Table 16

Relative Humidity (%) and Mean Temperature (°F.) in Winter

Month & Yr.	Oct. 23	Nov. 23	Dec. 23	Jan. 24	Feb. 24	Jan. 25	Feb. 25
No. of Obs.	25	23	9	15	20	14	17
Mean Temp.	6.4	-12.6	-30.8	-23.1	-29.6	-10.3	-19.8
R.H. (ice)	98.0	102.3	101.6	103.5	103.0	97.6	98.4

During the expedition of the "Fram" in February, 1894, the observed monthly value averaged as high as 129%, although the same value with respect to water would have been only 92% at the mean temperature of -32.1° which prevailed that month. So the values usually given for relative humidity do not represent conditions as to condensation or sublimation of hoar frost on icy surfaces or on ice or snow crystals introduced into the air by wind, or falling through the supersaturated air from clouds above. It should be mentioned that these high values for the relative humidity over ice at such low temperatures are subject to considerable error due to inaccuracy of thermometers, and difficulty in reading them close enough to eliminate appreciable errors. However, even the closest calculations give values over 100%, and observed deposition at humidities with respect to water as low as 75% indicates that such conditions of supersaturation actually exist.

During periods of calm the surface relative humidity is usually high in AW and PW air masses. In the inversion the humidity falls to 50% or 60%, and above the inversion it remains fairly constant, unless warm moist air is being introduced aloft from lower latitudes, in which case a marked rise in humidity may occur even at 15,000 or 20,000 feet. Thus, any fog or cloud will usually be confined to the layer below the inversion, and in cAW air (cAK air at source) which lies sometimes for long periods over the polar ice, or in cPW air stagnating over Siberia or Canada, the layer of high humidity or fog layer may be only a few feet thick, and where there is any air drainage will be absent.

The only cases where really low relative humidities are observed are where winds are offshore, or downslope as near glaciers and mountain ranges. Mean humidities for Foka-Bay on Novaya Zemlya are given in the following table, arranged according to offshore and onshore components. Naturally the average for offshore winds is appreciably lower than for onshore winds, and the difference is greater in winter (December-March) than in summer:

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Table 17

Effect of Wind Direction on Relative Humidity (%)

Place	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Ann.
Foka Bay#	--	82.0	92.1	92.2	92.4	93.8	94.1	94.2	91.9	83.3	83.3	84.8	91.0
Foka Bay*	--	79.8	81.5	87.1	78.5	81.3	83.5	82.2	82.9	77.6	74.7	74.6	79.5

#Onshore wind.
*Offshore wind.

The effect of wind direction shows up in the seasonal averages of relative humidity. For instance, at Coppermine the relative humidity averages 73.3% in winter and 81.2% in summer. Part of this difference is due to the fact that in summer the continent is warm and pressure is lower in the interior so that an onshore wind prevails, giving higher humidity at the surface than in the winter when the continent is cold and pressure higher there than immediately offshore. At stations situated otherwise with respect to the continent, a different seasonal effect is noted. The interior Arctic stations show higher humidity in winter than in summer due to the lower temperatures and to the confining of the moisture to the lower layers by the surface inversion which prevails over the interior of the continent throughout the winter. Even proximity to the large water area of Hudson Bay does not seem to reverse the trend of the humidity as it does along the Arctic coast where the monsoonal influence is more pronounced. Along the Atlantic and Pacific coasts of North America there will be found a summer maximum in relative humidity as along the Arctic coast, while in the interior of the United States there is usually a winter maximum, as in the Arctic continental regions.

In Greenland, on the other hand, the Interior Ice stations show summer maxima and the coastal regions winter maxima, which is just the reverse of the condition found on the ice-free continents. This is due to altitude and foehn effects: the free air at 8,000 or 10,000 feet is exceedingly dry in winter as compared with summer (the ice being covered with dry snow) and does not stagnate over the Inland Ice, while in summer the ice is mushy with large pools of stagnant water, and wind velocities are lower so that humidity builds up at that season. On the northern coasts of Greenland, however, the contrast between the temperatures on the ice cap and in the lowlands and the frequent cyclonic storms in summer cause prevailing downslope winds that are dried by compression, giving low summer humidities, while in winter pools of extremely cold stagnant air collect in the fjords for days at a time, giving higher averages.

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Table 18

Mean Relative Humidity (%) by Seasons at Continental and Coastal Stations

Continental Stations			Coastal Stations		
Station	Summer	Winter	Station	Summer	Winter
Fairbanks	48	78	Nome	83	76
Chesterfield	87	92	Barrow	87	81
Meanook	74	85	Coppermine	81	73
Hopes Advance	85	89	"Fram"	94	82
Olekminsk	67	80	"Maud"	96	78
Verkhoyansk	60	72	"Sedov" Foka Bay	91	80
West Station*	83	76	Danmarkshavn**	79	84
Eismitte*	86	79	Angmagssalik**	73	82

*Stations on Greenland Ice Cap.
**Stations on northeast Greenland coast.

This table further bears out the fact that it is difficult to judge the moisture content of the air by the relative humidity alone. For instance, Coppermine in August has a mean relative humidity of 79% compared to 91% at Foka Bay. The corresponding vapor pressures for August are: 10.80 and 6.32 mb., respectively, the air mass over the station with the lower relative humidity having the greater actual moisture content due to a higher mean temperature. In spite of this tendency, however, the stations north of Eurasia show the greatest difference between summer and winter relative humidities, emphasizing the maritime nature of the air masses in that section of the Arctic, where slighter differences in relative humidity would be expected since the annual range in temperature is less than it is at, say, Coppermine.

Table 21 gives the monthly march of mean relative humidity, to show the possible variation in air masses originating in various source regions during the different months. Although it is apparent that relative humidity is one of the least conservative meteorological elements it will be found that there is very little variation in mean monthly relative humidity in the Arctic regions from year to year, since the humid nature of the surface, ice in winter, and water in summer, tends to greatly increase the moisture content during warm months and only slightly increase the absolute humidity during cold months. Another limiting factor on humidity variation is the high incidence of 100% humidities (with respect to water as is given in all climatic tables unless otherwise specified) due to condensation at higher humidities.

Table 19 shows the annual variation in mean relative humidity at Ellesmere Land as shown in the "Fram" tables.

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Table 19

Annual Variation in Relative Humidity (%) at Ellesmere Land

Year		1899	1900	1901	1902
January Mean	RH (%)	82.9	81.5	83.0	85.6
June Mean	RH (%)	74.0	79.2	85.5	78.3
Annual Mean	RH (%)	80.4	81.3	86.3	79.2

(June was used instead of July since there were only two complete years' record in July.) It can be seen that the variation in January was only 4.1% while in June it was 11.5% in 4 years. While this is quite a range, it is slight compared with the possible range from day to day of from, say, 20% to 100%, or even the diurnal ranges found in some places of from 30% to 90% or even greater. At most Arctic stations the range during the year, also, is not excessive, Barrow showing a range of from 80% to 88%, Nome from 74% to 86%, and Green Harbor from 76% to 83%, ranges of only 8%, 12%, and 7%, respectively, between seasonal extremes. At Kazalinsk on the Aral Sea (desert type) the range is 49% (from 34% to 83%).

Table 20 shows the diurnal range in relative humidity as observed on the "Fram" in south Ellesmere Land during the years 1898 to 1902. (The diurnal range in vapor pressure in August is from 5.68 mb. at 10 h. to 6.01 at 18 h., a range of only .33 mb. or 5.5%.)

Table 20

Diurnal Range in Relative Humidity (%) in South Ellesmere Land, 1898-1902

Hour	2h	4h	6h	8h	10h	12h	14h	16h	18h	20h	22h	24h	Ra.*
Jan.	83.0	83.0	83.4	83.1	83.1	83.3	83.3	83.7	83.6	83.3	83.1	83.1	0.7
Feb.	85.1	84.8	84.3	84.4	84.3	84.0	83.8	83.7	84.6	84.8	84.3	84.4	1.4
Mar.	80.6	81.0	80.9	80.6	80.6	79.3	79.0	79.6	79.7	80.3	80.3	80.1	2.0
Apr.	83.5	83.0	82.5	81.0	79.5	78.6	78.5	78.4	79.2	81.2	82.8	83.4	5.1
May	82.1	81.3	79.6	78.7	77.4	76.1	76.3	76.8	77.8	79.0	80.2	81.4	6.0
Jun.	82.2	81.9	80.8	79.4	78.2	76.8	76.2	76.9	77.4	78.5	79.9	82.0	6.3
Jul.	84.8	84.4	84.6	83.4	82.4	80.5	79.1	79.1	79.7	81.3	82.6	84.1	5.7
Aug.	89.3	89.4	89.1	89.3	86.9	85.2	84.3	82.6	85.2	86.4	88.0	88.7	6.8
Sep.	86.3	86.7	85.2	84.0	83.3	83.0	83.0	83.6	85.8	86.4	85.7	86.3	3.7
Oct.	82.3	81.7	81.5	80.6	81.2	80.0	80.5	80.2	82.5	82.3	82.6	83.0	3.0
Nov.	81.7	81.4	81.7	81.4	81.9	81.2	80.6	80.9	80.5	80.8	81.1	81.2	1.4
Dec.	84.1	84.3	83.8	83.8	84.0	83.4	83.3	83.2	83.8	83.6	83.6	84.2	1.1

*Mean diurnal range.

We can see that the highest average humidity comes between midnight and 4 a.m., and the lowest between noon and 4 p.m., during all the months except January, when the diurnal maxima and minima are exactly reversed (the diurnal temperature extremes are also reversed during January at most stations on the Arctic Ocean and the Canadian Archipelago). The mean diurnal relative humidity ranges are slight at any season, the lowest range of less than 1% occurring in January, and the highest of 6.8% in August. Compare this extreme range with that in Helwan, Egypt in July of 53% (from 22% to 75%).

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It has been shown that in the Arctic the variations of relative humidity with wind direction, with altitude, and from place to place may be considerable, but that diurnal, seasonal, and annual variations are slight. An examination of tables 18 and 21 will show that the winter horizontal variations in relative humidity are not so great as those in summer (Verkhoyansk in January 72%, to Chesterfield in January 93%, range 21%) (Fairbanks in July 48% to Pack-Ice (Maud) in July 96%, range 48%), while the absolute humidity variations over the Arctic are greater in winter than in summer (table 15): (Chesterfield in January 0.41 mb., Jan Mayen in January 4.36 mb. vapor pressure), (Foka Bay in July 5.69 mb. Chesterfield July 9.25 mb. vapor pressure).

It would therefore be expected that great changes in relative humidity might be expected with changes of air mass in summer, although the actual water vapor content would not be affected very much. This is borne out by the fact that cloudiness and precipitation will occur at almost any time, in almost any place, and in almost any air mass in the Arctic summer. On the other hand, in the winter precipitation amounts are slight throughout the Arctic, but are extremely variable, occurring only in Maritime air or when an air mass changes from Maritime to Continental or vice-versa. This is in agreement with the absolute humidity variations (as represented above in terms of vapor pressure) which indicate that in cA air, for instance, like that originating near Chesterfield, so little moisture exists even at the surface as to preclude any but the slightest amounts of snowfall, while in mA as in mP air, amounts comparable in moisture content with summer masses could be obtained. It is easy to see how important a knowledge of changes in air mass can be to the forecasting of weather conditions, especially in the winter and along the interfrontal zones.

It frequently happens that, with a change in air mass, both the temperature and relative humidity will drop, so that for example, a drop of from 95% to 54% in relative humidity would mean an even greater drop in vapor pressure: 17.7 mb. to 9.5 mb. in 24 hours (temperature drop 6.1° F.) in mT and cA air, respectively. The above actually occurred over the Atlantic Ocean in May. Even greater differences would be found in the early or late winter in higher latitudes. For instance at Foka Bay on Novaya Zemlya, on March 5, 1913, at 10 a.m. the relative humidity was 100%, while at 4 a.m. on the 6th the relative humidity was 48%, a change of 52% in 18 hours. At the same time the temperature dropped from 26° F. to 9° F. and although the wind only changed from southwest 45 m.p.h. to south-southwest 30 m.p.h., the passage of a front was indicated by the drop in vapor pressure from 4.6 mb. to 1.2 mb., or the corresponding drop in specific humidity from 3.0 to 0.7 g/kg, a rise in pressure from 999.1 mb. to 1003.9 mb, and the onset of snow.

Such changes in relative humidity as mentioned above can occur in any month of the year with the passage of a front. The greatest change in one day at Foka Bay, during the year 1912-13, was from 98% to 39%, or 59% range, and in this instance, on June 13, 1913, the humidity dropped from 90% to 39% in 4 hours, while the vapor pressure dropped from 5.5 mb. to 3.5 mb. This is another example of the greater drop in relative humidity causing a slighter change in actual moisture content in summer, the temperature in this case rising 10° with the passage of the front.

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To summarize: The first humidity element to consider is the actual water vapor content, or specific humidity of the air mass. Specific humidities in cA and cP air masses in winter are very low, both at the surface and aloft. mA and mP masses contain large amounts of moisture, considering the stability of the air and hence, the chance of the moisture being precipitated at the slightest provocation. Most summer masses throughout the Arctic are of a fully or partially maritime character: unstable and full of moisture, precipitation, ice, turbulence, and cloud. Relative humidity is a most important consideration in stable masses where it is a good indicator of the probability of fog formation under the inversions, or near the pack ice. Variations in relative humidity are well marked only in respect to altitude (mAk and mPk air), and between cA and mA air masses, where foehn effects are prevalent, and in the few cases where cTw air invades the Arctic.

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Table 21

Mean Monthly Relative Humidity (%) at Arctic Stations (with respect to water*)

Stations	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Alaska													
Barrow	84	80	80	80	84	87	86	88	88	86	83	80	84
Nome	74	77	74	80	78	79	86	85	82	80	76	78	79
Fairbanks	81	72	50	41	39	41	48	55	55	67	79	82	59
Canada													
Coppermine	74	73	78	81	89	87	78	79	81	78	76	72	79
Chesterfield	93	90	90	89	88	87	86	88	91	95	91	92	90
Cape Hopes Advance	87	92	87	89	88	85	82	85	91	85	87	88	88
Moanok	88	82	81	70	69	74	76	73	70	82	84	85	78
Fort Rae	-	-	-	71	72	71	68	76	78	84	-	-	-
Edmonton	82	78	75	66	61	68	70	75	72	70	77	81	73
Winnipeg	88	81	77	71	62	68	69	73	78	78	80	83	76
Fort Conger	-	-	-	-	79	79	80	79	84	83	-	-	-
South Ellesmere Land	83	84	80	81	79	79	82	87	85	82	81	84	82
Greenland													
West Station	73	81	75	82	79	86	77	85	75	76	76	75	78
Mismitto	80	77	78	81	86	84	88	84	84	80	79	78	82
Angmagssalik	83	82	81	79	77	74	73	72	73	80	80	81	77
Dannarkshavn	84	81	88	78	80	80	80	76	70	74	86	87	80

*Stations in the United States and Alaska show relative humidities up to 100% with respect to ice when temperatures are below 32° F.

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Table 21 (cont.)

Mean Monthly Relative Humidity (%) at Arctic Stations (with respect to water*)

Stations	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Siberia													
Verkhoyansk	72	71	68	60	55	53	59	69	75	78	76	74	67
Olekminsk	81	78	69	60	60	61	66	73	76	79	83	82	72
Sagastyr	85	85	86	87	89	91	92	90	90	89	88	84	88
"Maud" Coast	78	78	78	84	86	84	-	-	91	86	84	78	-
"Maud" Pack Ice	78	74	-	-	87	93	96	96	93	85	80	73	-
"Fram" Pack Ice	81	85	-	-	-	-	-	-	-	-	80	81	-
Arctic Ocean													
"Sedov"-Feka Bay	80	81	85	89	88	92	91	91	90	81	79	79	86
Green Harbor	81	80	80	77	76	82	81	83	82	80	79	82	80
Baren Island	86	83	80	82	84	88	85	83	84	82	85	86	84
Jan Mayen	84	83	81	82	82	86	90	86	83	82	81	83	84

*Stations in the United States and Alaska show relative humidities up to 100% with respect to ice when temperatures are below 32° F.

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Table 22

Mean Monthly Relative Humidity Aloft (%)
(from Radiosondes Made in Alaska, 1941-42)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Fairbanks													
Number of Observations	31	28	31	30	31	30	31	31	31	30	30	31	363
Elevations Meters Sea Level													
Surface (156 m.)	83	72	57	46	40	42	51	62	56	72	81	78	61
500	82	75	61	48	41	43	54	64	56	75	83	77	62
1000	74	77	63	51	44	47	60	67	61	77	80	74	63
1500	69	75	65	55	49	52	68	71	65	78	78	69	64
2000	66	73	65	58	55	57	76	76	66	76	77	67	66
2500	64	72	65	60	61	62	80	81	65	74	73	66	66
3000	63	71	65	61	66	63	81	81	62	72	67	63	66
4000	61	71	65	63	69	66	73	76	58	70	65	62	63
5000	59	70	66	63	67	66	66	74	56	67	63	60	60
6000	59	69	-	61	64	63	65	71	56	67	61	59	58
7000	-	-	-	-	62	61	62	68	53	-	-	-	-
8000	-	-	-	-	61	59	62	66	-	-	-	-	-

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Table 22 (cont.)

Mean Monthly Relative Humidity Aloft (%)
(from Radiosondes Made in Alaska, 1941-42)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
						Nome							
Number of Observations	27	16	30	30	31	30	29	19	30	30	30	31	355
Elevations Meters Sea Level													
Surface (14 m.)	74	74	72	79	73	75	84	79	70	78	79	83	76
500	75	79	74	79	76	71	84	82	72	81	80	83	75
1000	73	79	71	78	71	73	84	85	72	80	77	80	74
1500	71	76	69	78	68	74	85	84	72	76	72	77	71
2000	69	71	66	77	67	74	82	83	67	73	66	73	67
2500	68	64	65	75	65	71	75	84	66	71	62	68	65
3000	67	60	63	74	65	67	70	84	64	70	59	66	63
4000	65	55	63	71	63	64	65	73	56	66	55	64	58
5000	64	55	62	69	60	59	60	69	55	59	54	63	55
6000	63	55	63	67	58	55	56	65	51	56	53	62	53
7000	-	-	-	-	58	53	53	62	50	55	-	-	-
8000	-	-	-	-	-	51	51	61	50	-	-	-	-

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Table 22 (cont.)

Mean Monthly Relative Humidity Aloft (%)
(from Radiosondes Made in Alaska, 1941-42)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Barrow													
Number of Observations	31	28	30	30	31	30	31	31	31	31	30	30	365
Elevations Meters Sea Level													
Surface (6 m.)	89	90	90	93	92	92	87	92	86	92	91	88	91
500	88	91	91	90	90	78	77	83	79	87	88	87	85
1000	83	85	91	81	78	64	75	73	69	79	83	84	77
1500	77	82	88	75	69	60	77	68	63	76	80	80	71
2000	75	78	84	69	63	58	75	65	60	74	78	72	68
2500	73	75	80	66	60	58	74	63	56	73	77	67	66
3000	72	74	77	64	58	58	69	61	54	72	75	66	64
4000	67	72	75	60	59	58	64	60	52	68	72	65	61
5000	64	70	75	59	55	53	62	57	50	64	70	66	59
6000	62	-	-	59	54	50	59	55	49	61	-	-	55
7000	-	-	-	-	52	49	58	53	49	-	-	-	-
8000	-	-	-	-	-	-	57	53	-	-	-	-	-

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FREQUENCY OF CYCLONIC STORMS

Cyclonic storms tend to follow the boundaries of the Arctic or Polar air masses in the Polar regions. In the winter when these boundaries are well defined and the contrast between the Continental and Maritime, or the Arctic and Polar air masses, or combinations of the same, is marked, the storms are fewer and more intense and have longer life histories.

The frequency of cyclonic storms in the higher latitudes varies with the season, the position of the major fronts, the latitude and the existence of semipermanent air masses such as the one which persists over northeastern Siberia most of the winter. There may be a difference of 100% in the number as well as the intensity of such storms between one year and the next in a given season.

The accompanying charts of storm tracks, plotted from data on the U.S. Weather Bureau Northern Hemisphere Charts for various months, show the general direction of movement, speed of movement, length of life, regions of cyclogenesis and mean paths of cyclonic storms and waves for the months selected. Every month of the year except January is represented, the omission of January being due to the lack of analyzed charts for that month in any year. The other examples were taken from the years 1936 or 1937, if available, since during those years there were more complete data available for the Polar regions. If none for those years was obtainable, there was usually only one choice, or one complete month's maps to be used. Thus, it is possible that in some cases widely different results would have been obtained had another year or several years' maps been used. Where two years were plotted for the same month, the one that seemed most representative was used.

During the month of February the number of storm tracks in the United States and in eastern Siberia was at a minimum. The number in the Gulf of Alaska, the Hudson Bay region, southern Greenland and the Barents Sea was about normal. The total number of storms was below the average for the year, but those storms that did appear were well developed and moved slowly so that their influence, at least in the oceanic areas, was felt more than, say in August, when the number of storms was much greater. The interior of the continental areas was least affected by the storms, as the low potential temperature in the storms at that season tends to confine the bad weather to low altitudes and the coastal regions, while inland the storm is represented merely by a low pressure center and wind. In the Siberian region the storms seem to shun the northeastern peninsula, even the occluded centers being pushed south by masses of Arctic air from the "Pole of Inaccessibility" just north of that peninsula. Compare this effect with the opposite effect on the June map, when lower pressure over the Polar basin draws the storms north from the continent into the region previously shunned.

March shows an increase in both the number of storms and the activity, and there is a corresponding increase in bad weather over most of the Arctic, as more moist air from the temperate zone is invading the Arctic. Contrary to popular belief, the belt of storms in America has shifted south from the region between 50° and 70° N., to a belt between 40° and 60° N. This is due either to differences between one year and another in the zonal

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circulation or to the fact that the February storms are on the boundary between the Arctic and Polar masses, while the March storms are on the boundary between the Polar and Tropical masses, and both fronts have actually moved northward.

April shows a northward movement of the Polar Front in America and the Greenland area, and a tendency for storms to "stall" or loop in the Alaska region. There also seems to be a great deal of activity in the Barents and Kara Seas, and the storms and accompanying clouds are moving toward the Pole on the Atlantic side, indicating that poor flying weather would be encountered in that region. In the Fairbanks area, in spite of the greater number of storms that crossed any given point, the actual flying conditions were better than during March.

May shows a decrease not only in the number of storms in all regions, but in the intensity of the same, and in the amount of bad flying weather. This is just about the best month for flying on the whole, and the Polar Front is very weak except in the Atlantic area, and has receded even farther north than in March and April.

In June there was an increase in the number, though not in the intensity of the cyclonic storms. For the first time in the year the storms cross the northeast portion of Siberia and invade the Arctic basin on that side. There is no mean path of storms, and the only frontal zone is between the still cold Canadian Archipelago and Pack Ice between there and the Pole, and the warm regions of the Atlantic. So the Atlantic area appears to show a deterioration in good flying weather, while the Alaskan and Siberian areas show continued good weather on the whole. Although no surface data are available for the central Arctic basin, there is evidence of increase in storm activity, fog, low cloud, icing, etc. in that area, which continues or gets worse as the summer goes on, only decreasing late in August or early in September.

Over the continental areas in June, July, and August there are many short-lived, local storms, scattered over a wide latitude--in fact anywhere between the 45th. and 90th. parallel N.

Great variability exists from year to year in storm conditions during July and August. Some years there is a tendency for cold air masses to stagnate over the Arctic Ocean, producing a continual procession of storms, or waves, in the sub-Arctic regions, not to mention bad weather in the Atlantic area of the Polar basin due to contrast between the cold air and warm water. The storm activity also extends to a greater altitude, the upper limit of cloud, ice, and storm being around 30,000 feet rather than 15,000 or 20,000 feet as in winter. On the whole, it would be safe to say that the summer season is the most hazardous for flying over the Polar seas; and the best, if landing conditions as well as flying and storm conditions are considered, for flying over the sub-Arctic interior continental regions. The only exception to this would be covered by qualifying the term "summer" to include early autumn in the North Atlantic area where, due to the conservative properties of water, the summer lags a month or two longer than in the continental regions. In September the storm area still covers a broad range of latitude, but by October the Polar Front is again well developed, so that the storm belt is narrowed to the sub-Arctic and temperate zone north of 45°.

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November shows an increase in the intensity of storms although the number has not increased, and the frontal zone along which the storms move is better defined and encircles the globe. In the Arctic basin north of Siberia, the storms that in summer and until October moved almost to the Bering Sea meridian, or north to the Pole, die out before reaching the New Siberian Islands. This results in an improvement in flying weather over the Aklavik-Bulun route, and continued good weather in the Fairbanks-Kirensk section.

December is a month of violent storm activity in the North Atlantic and North Pacific, and there are occasional wide latitudinal exchanges of air which can completely change the picture of conditions in the Arctic. During one season the entire Arctic will be under the influence of stable Polar air so that storm activity will be at a minimum, and except for local fog conditions, flying weather will be ideal. Another year the December weather will be characterized by a procession of storms which give fluctuations in the weather every few days from extreme cold or Arctic type air to mild Maritime Polar air, with widespread precipitation attending each change. Thus, in many areas the weather may be bad almost every day during the month, with but brief respite.

Although no charts are available for January for the entire Northern Hemisphere the charts for North America which are found in the Monthly Weather Review show one year with absolutely no storms in the Arctic area, while in another year the Arctic Front is so poorly developed that storms cross the continent in any latitude. Another year there are many intense storms in the oceanic areas where the contrast between the Continental and Maritime air is extreme, while almost no storms cross the continents where clear, cold, dry air persists.

Two points should be emphasized in connection with this study. First it is impossible to forecast the mean position of storms tracks for any season by studying the paths during any previous season, as there is a wider divergence in many cases from year to year than from season to season. Even if a ten-year study were made, and the mean paths plotted, there would be no certainty that conditions would follow the mean pattern during the coming season. Of course, there are general paths and tendencies if broad areas are considered. Also it should be remembered that the paths shown are for the centers of low pressure, and in many represent the southern limit of storm activity, which may extend 600 miles from the center.

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Table 23

Number of Cyclonic Storms Crossing Each Airway

Stations	Feb. 1931	Mar. 1935	Apr. 1934	May 1936	June 1936	July 1935	Aug. 1937	Sep. 1937	Oct. 1933	Nov. 1936	Dec. 1936	11 Mos.
Great Falls-Fairbanks	5	5	9	3	4	4	6	5	10	6	10	67
Fairbanks-Kirensk	0	6	7	1	4	3	8	4	1	5	3	42
Kirensk-Moscow	2	6	5	1	3	2	4	3	2	8	4	40
Great Falls-Aklavik	7	5	9	4	6	4	9	6	7	6	11	74
Aklavik-Bulun	0	2	4	1	5	3	3	5	6	0	3	32
Bulun-Moscow	5	5	7	3	1	5	4	5	3	7	7	52
Fargo-Cape York	7	10	10	6	6	9	8	10	7	10	7	90
Cape York-Green Harbor	2	2	1	2	4	0	4	0	1	1	2	19
Green Harbor-Moscow	5	10	7	4	3	6	5	6	11	9	9	75
Cleveland-Julianehaab	4	8	8	7	10	6	8	10	7	12	6	86
Julianehaab-Moscow	4	12	7	6	4	10	10	8	7	10	8	86

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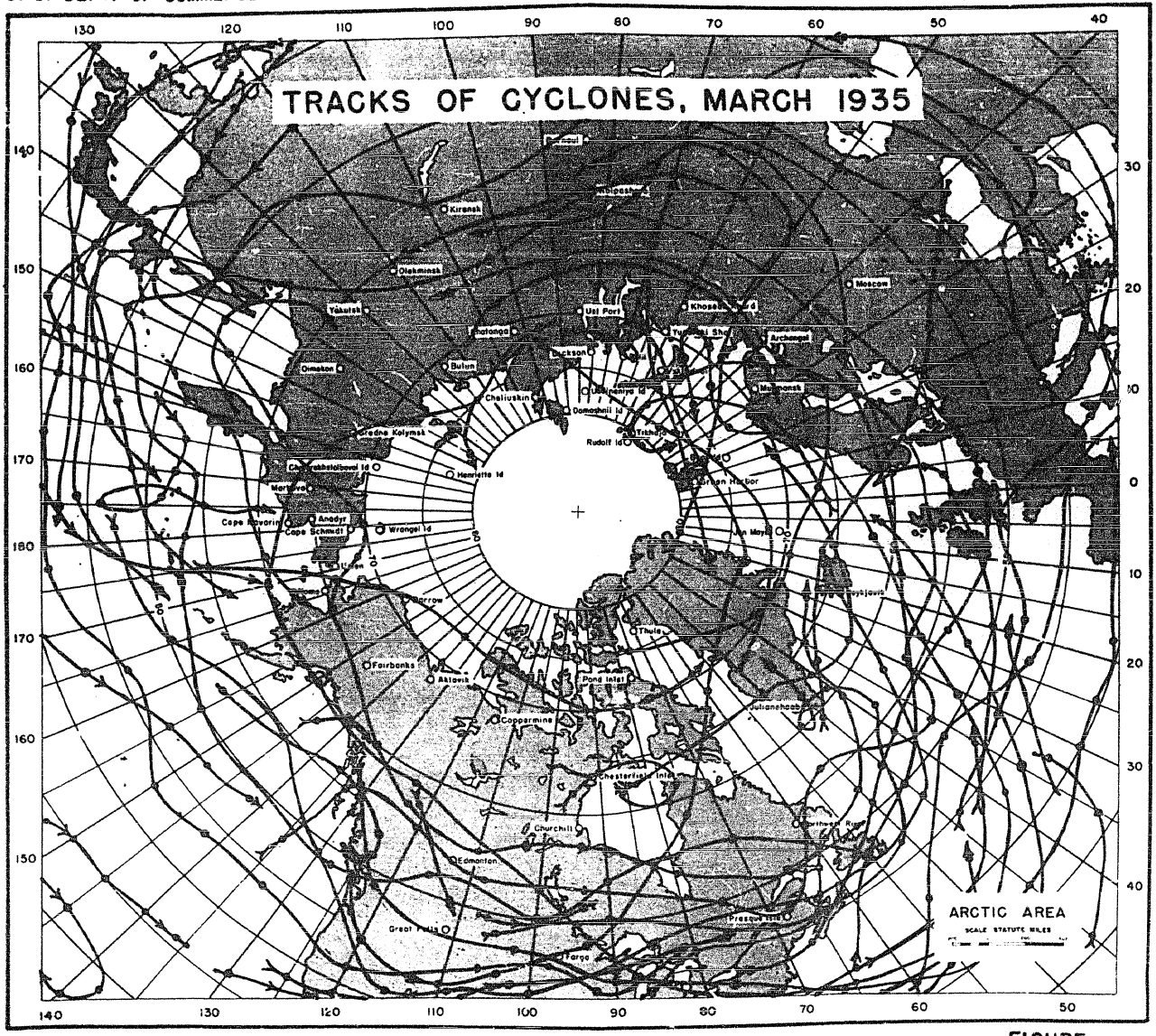

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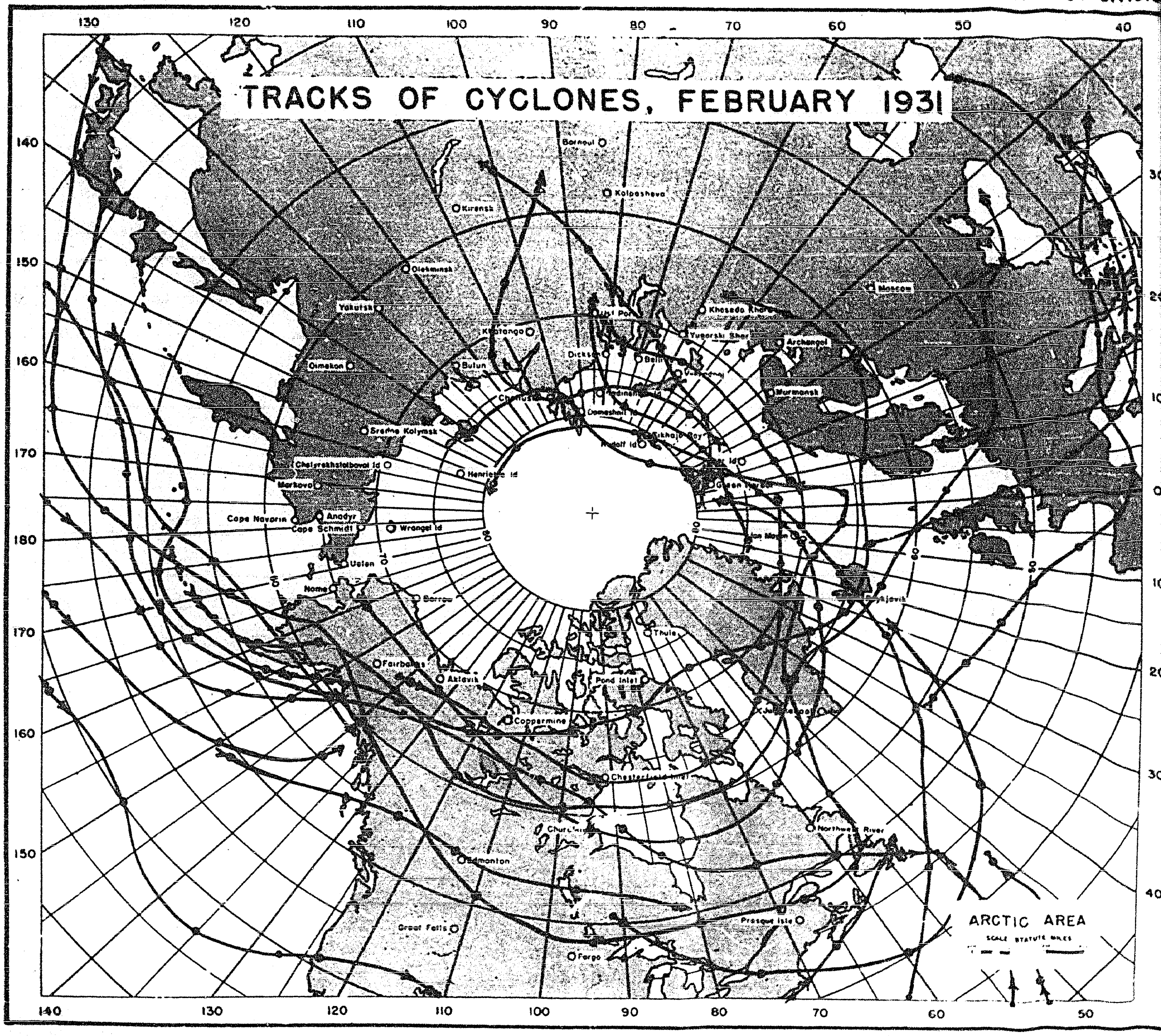

FILE STAT 422348 BASE STAT 422086-2 FIGURE 13

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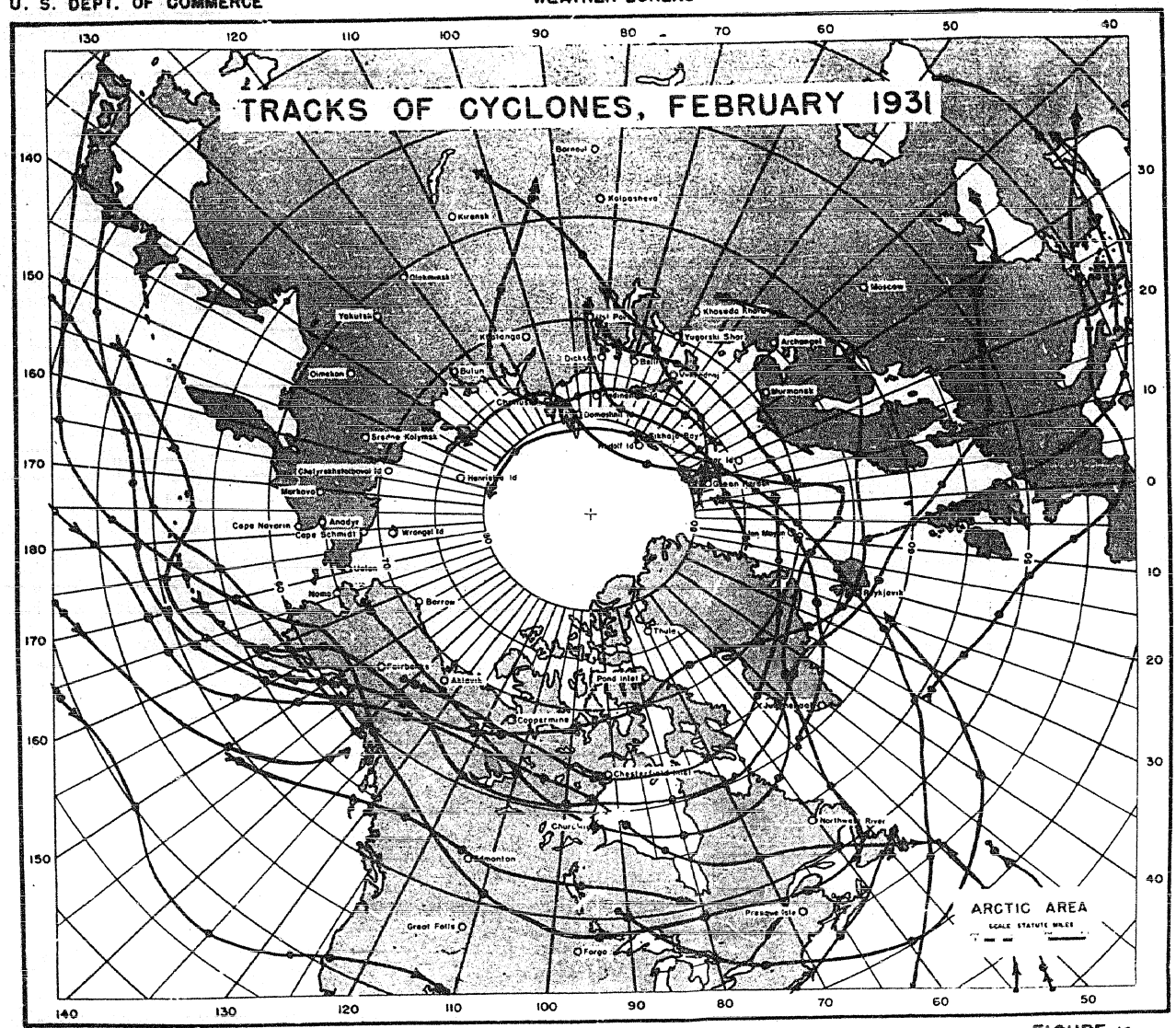

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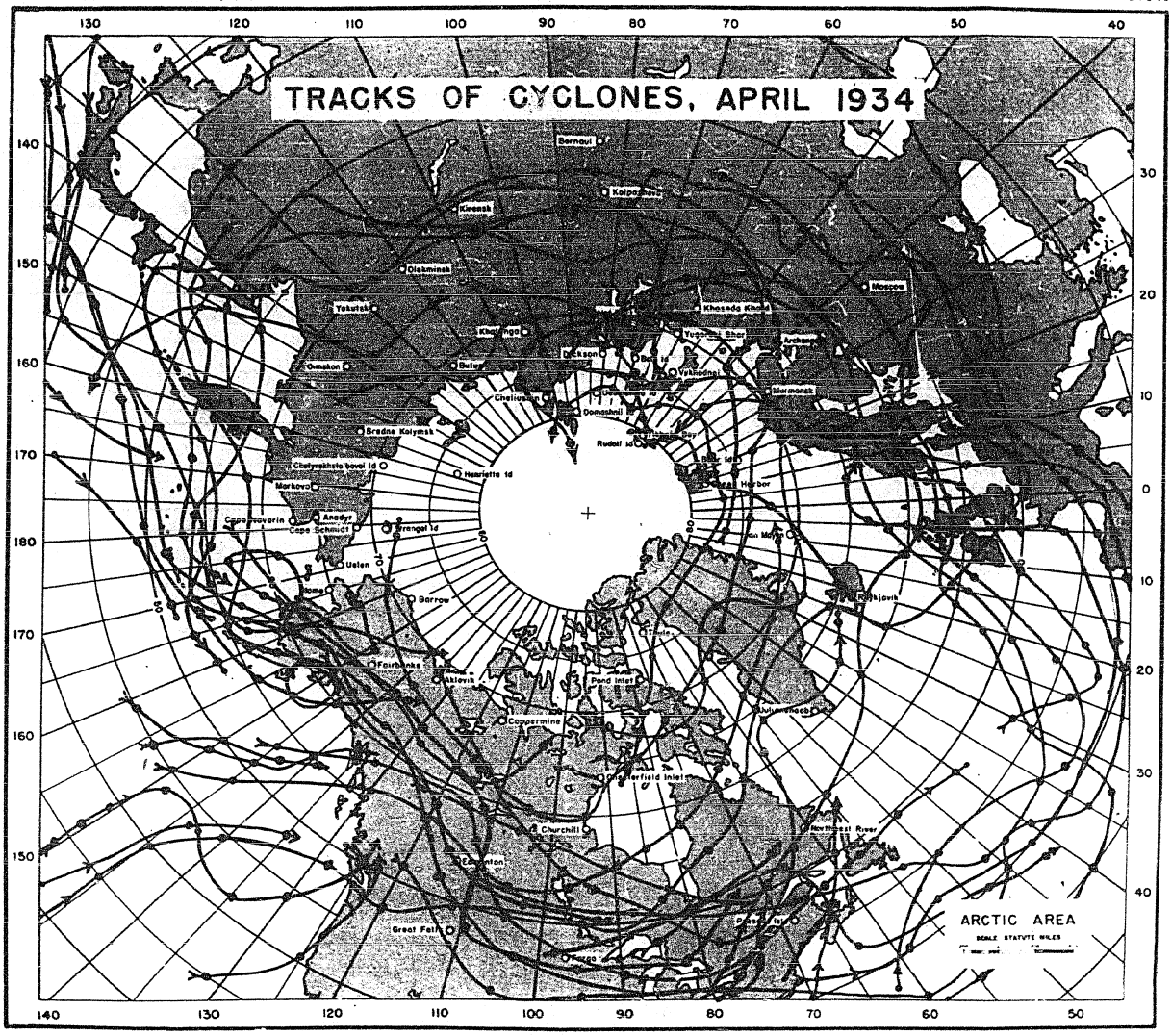

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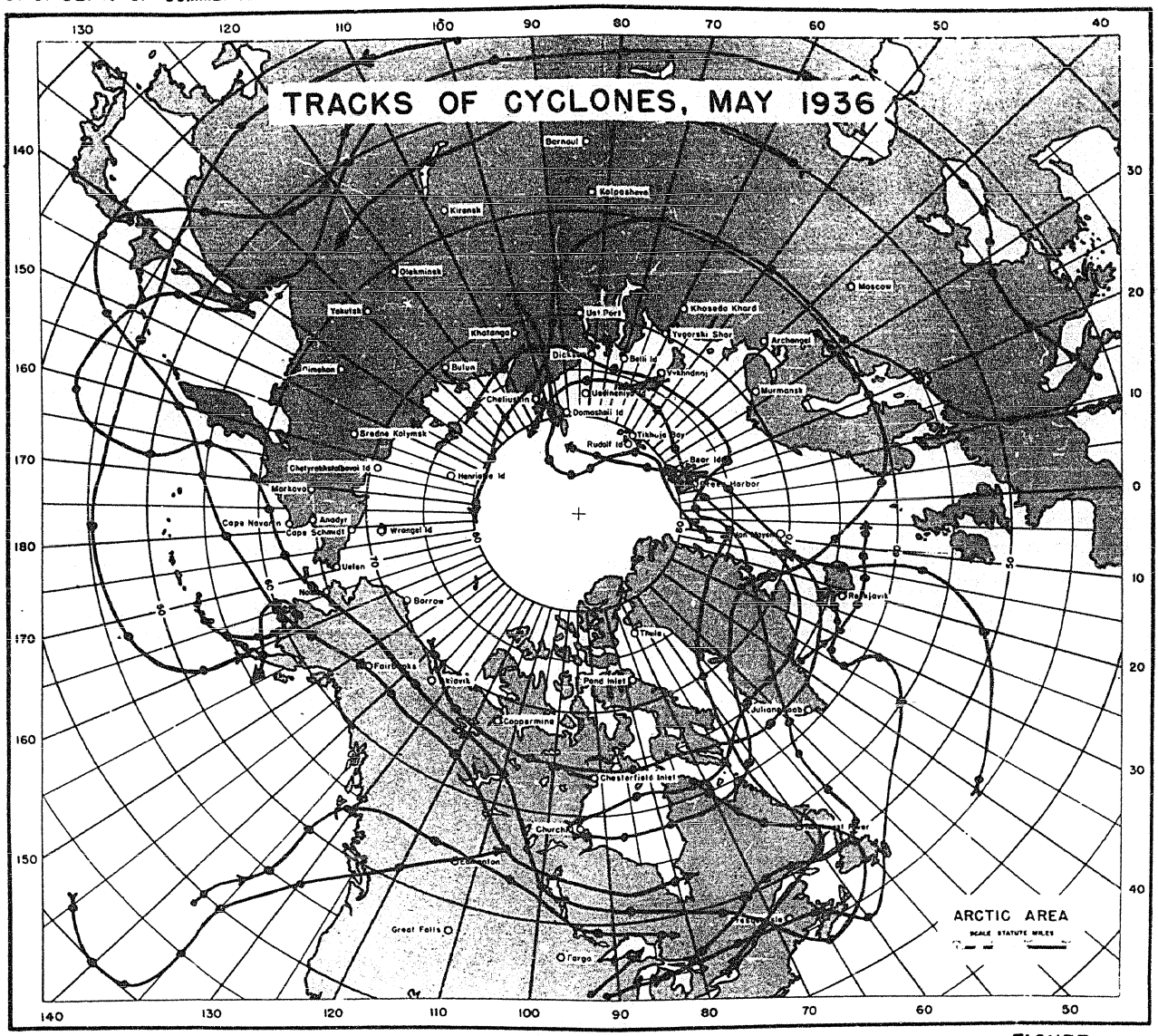

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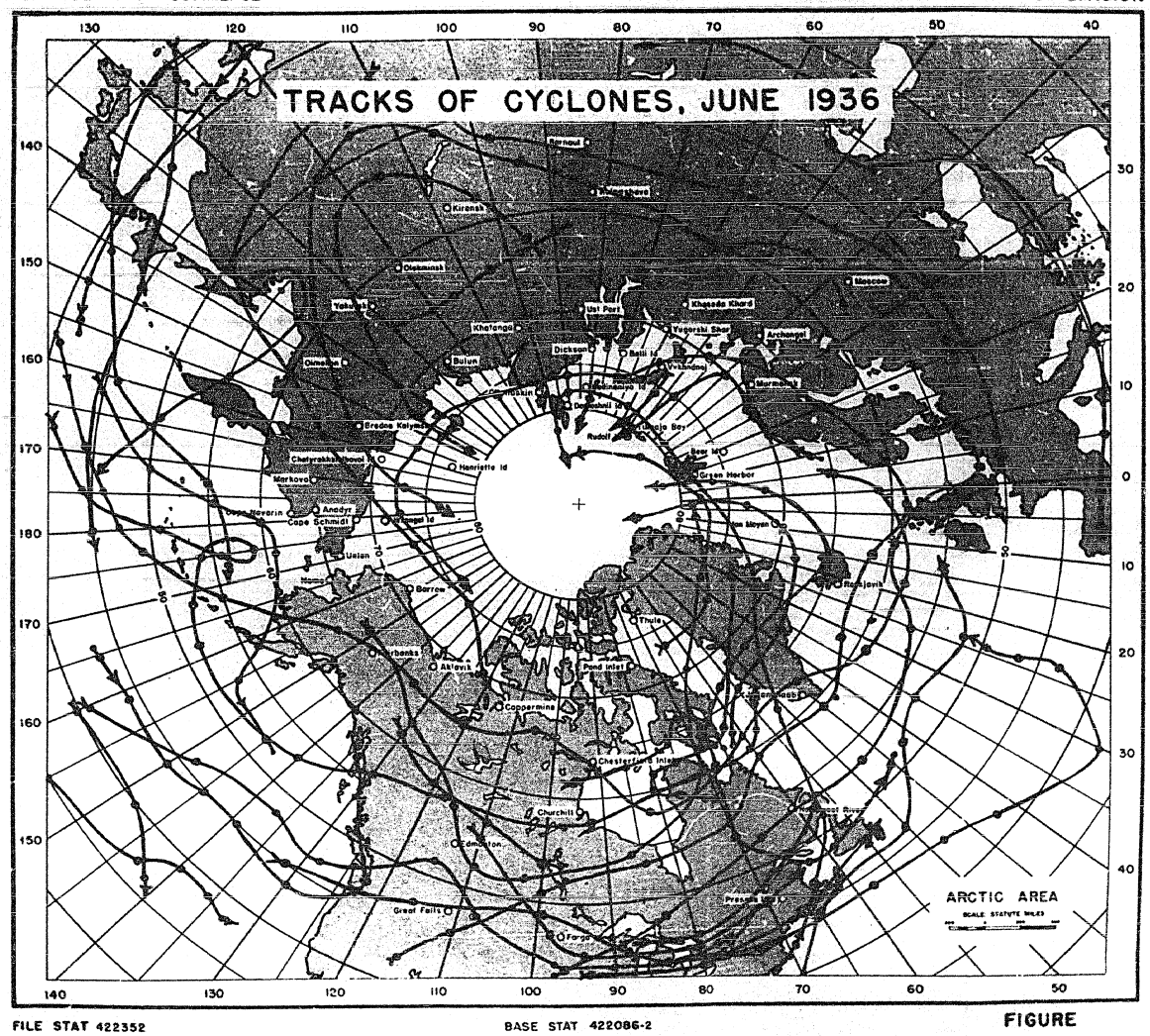

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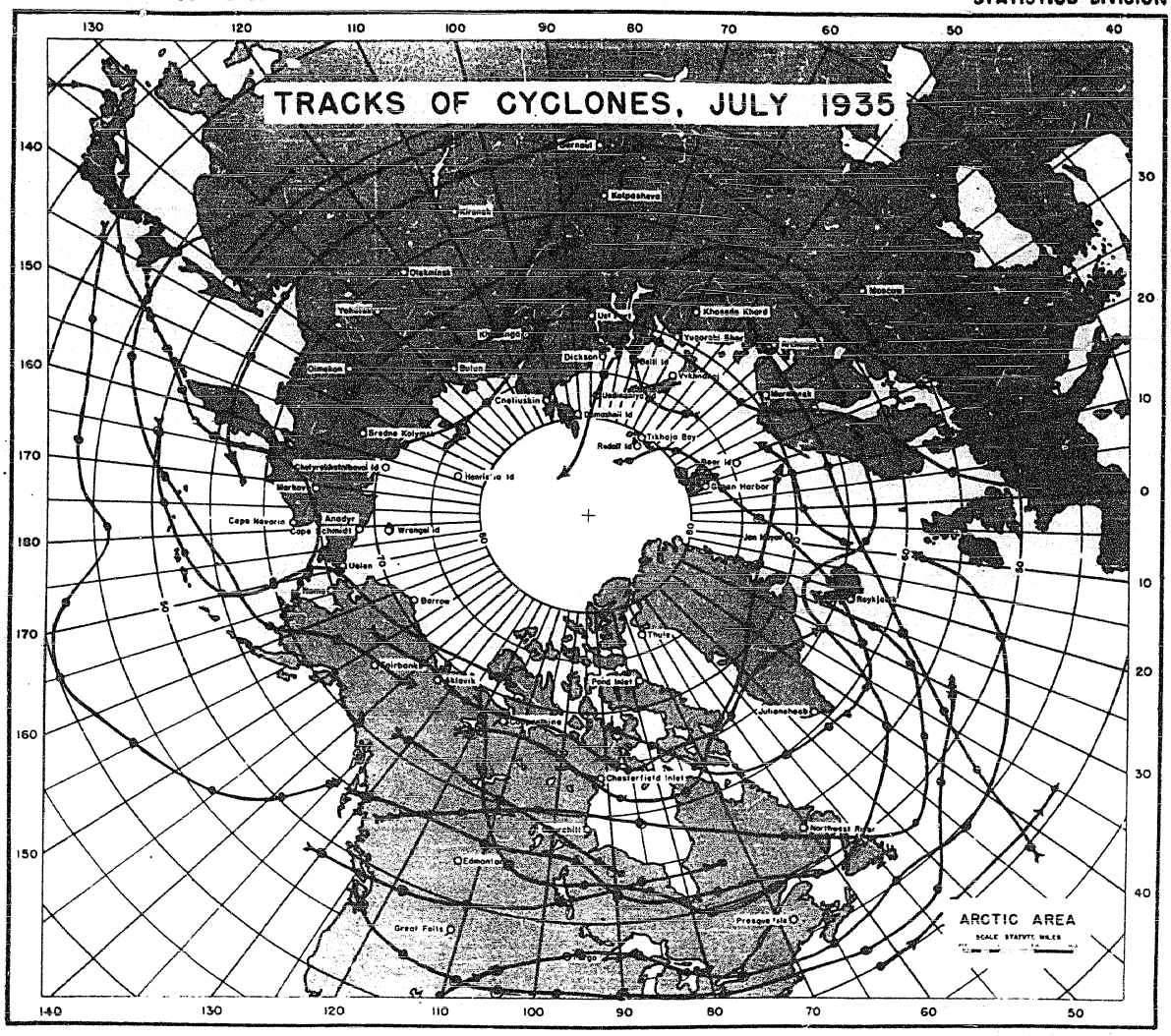

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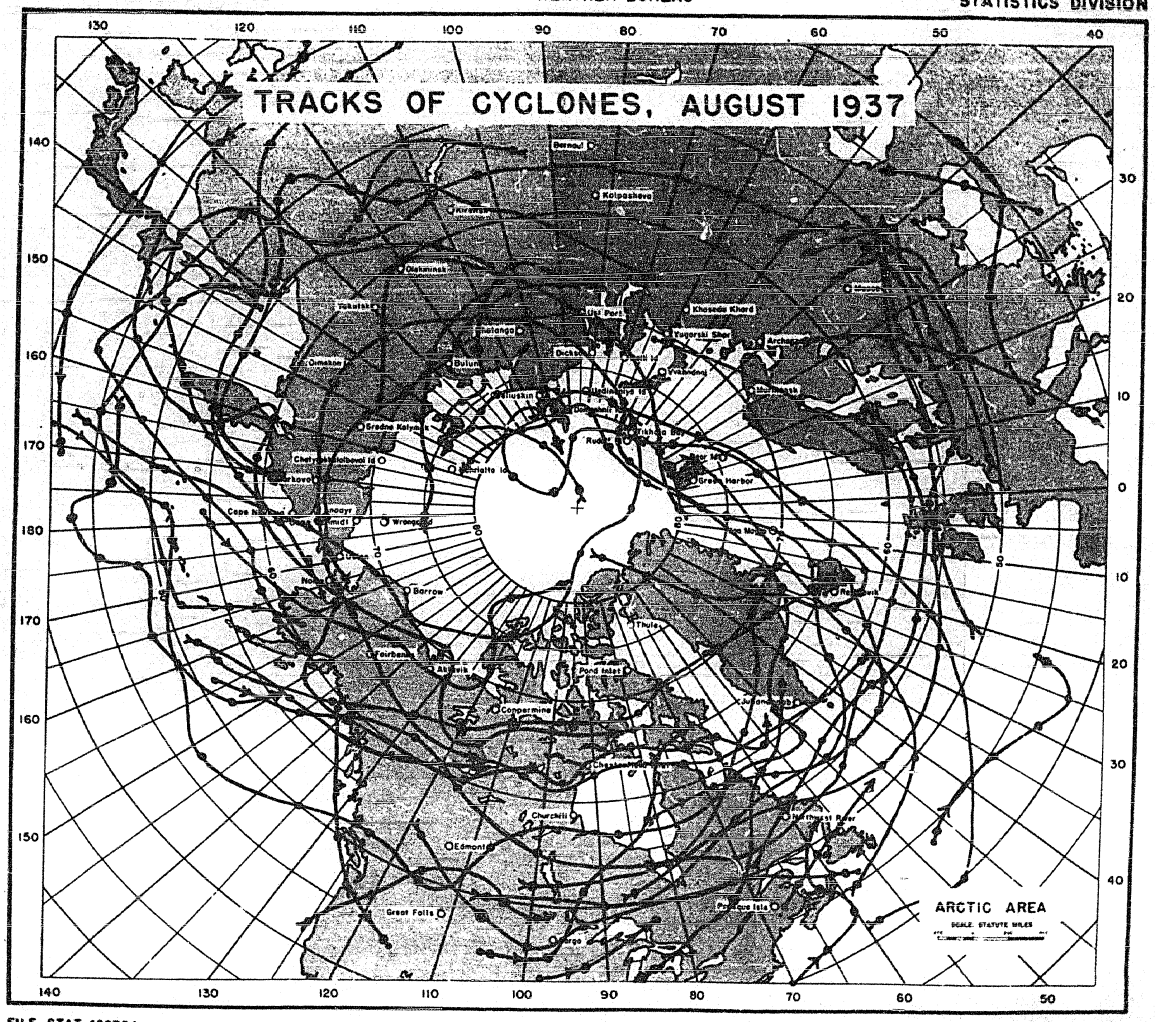

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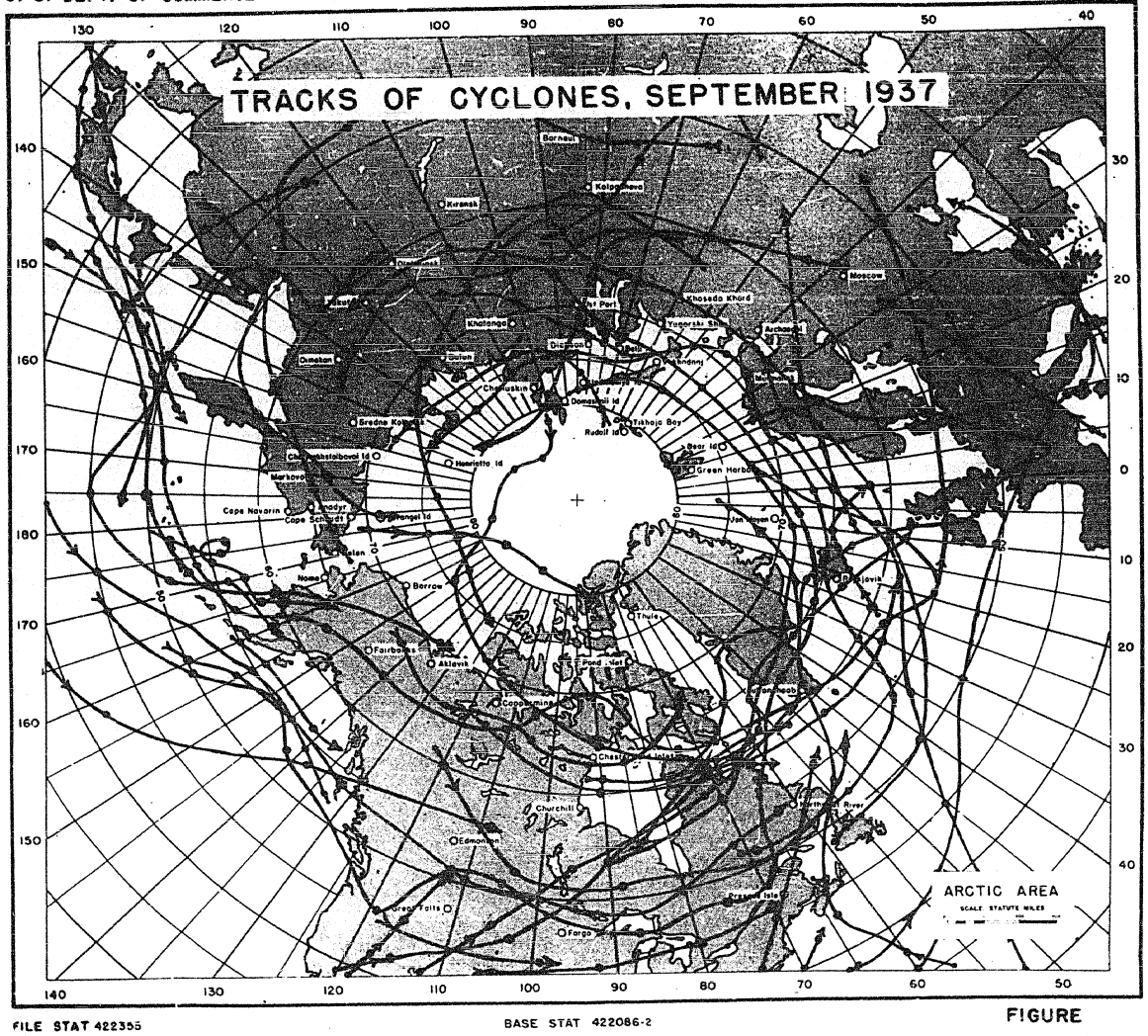

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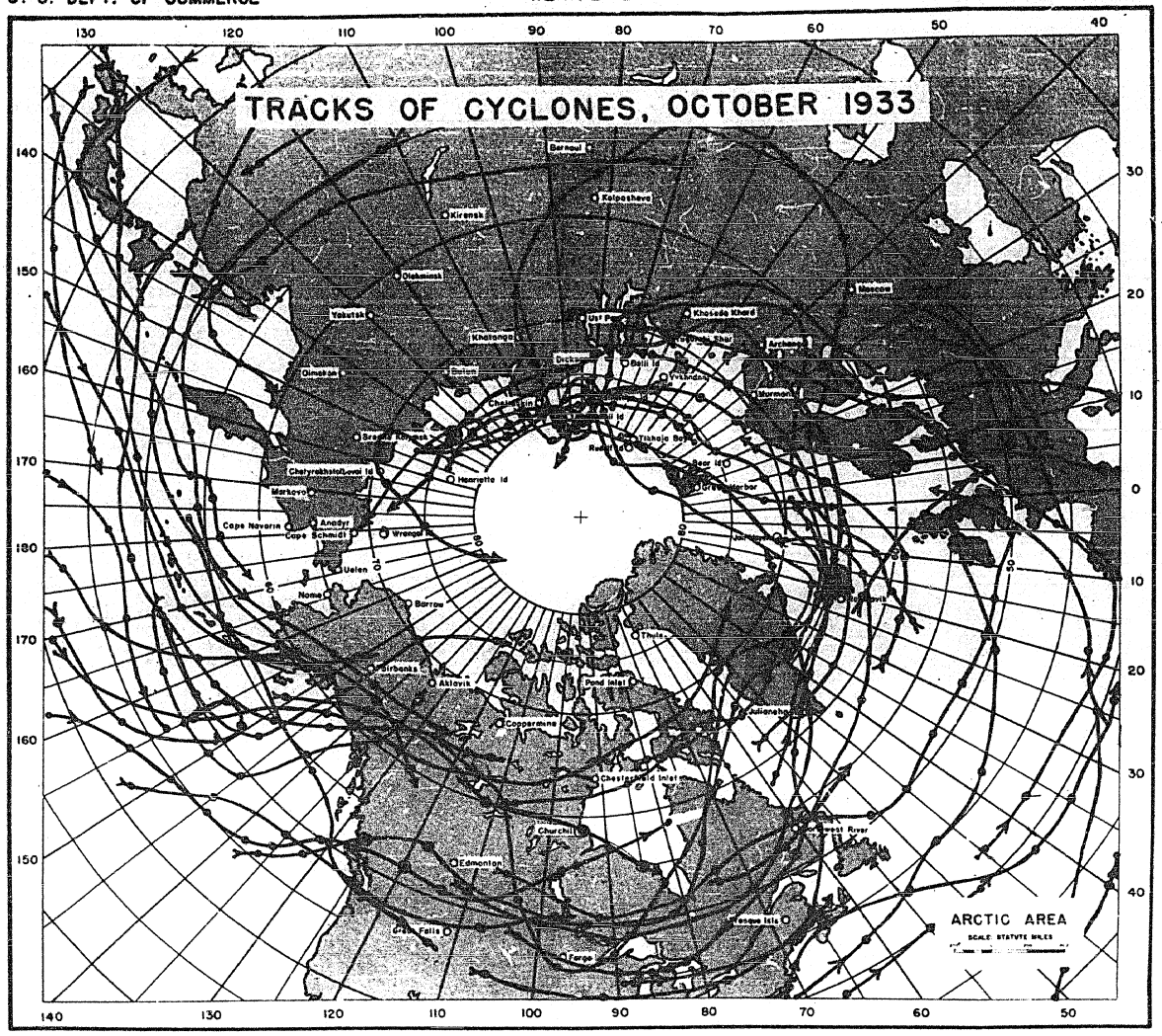

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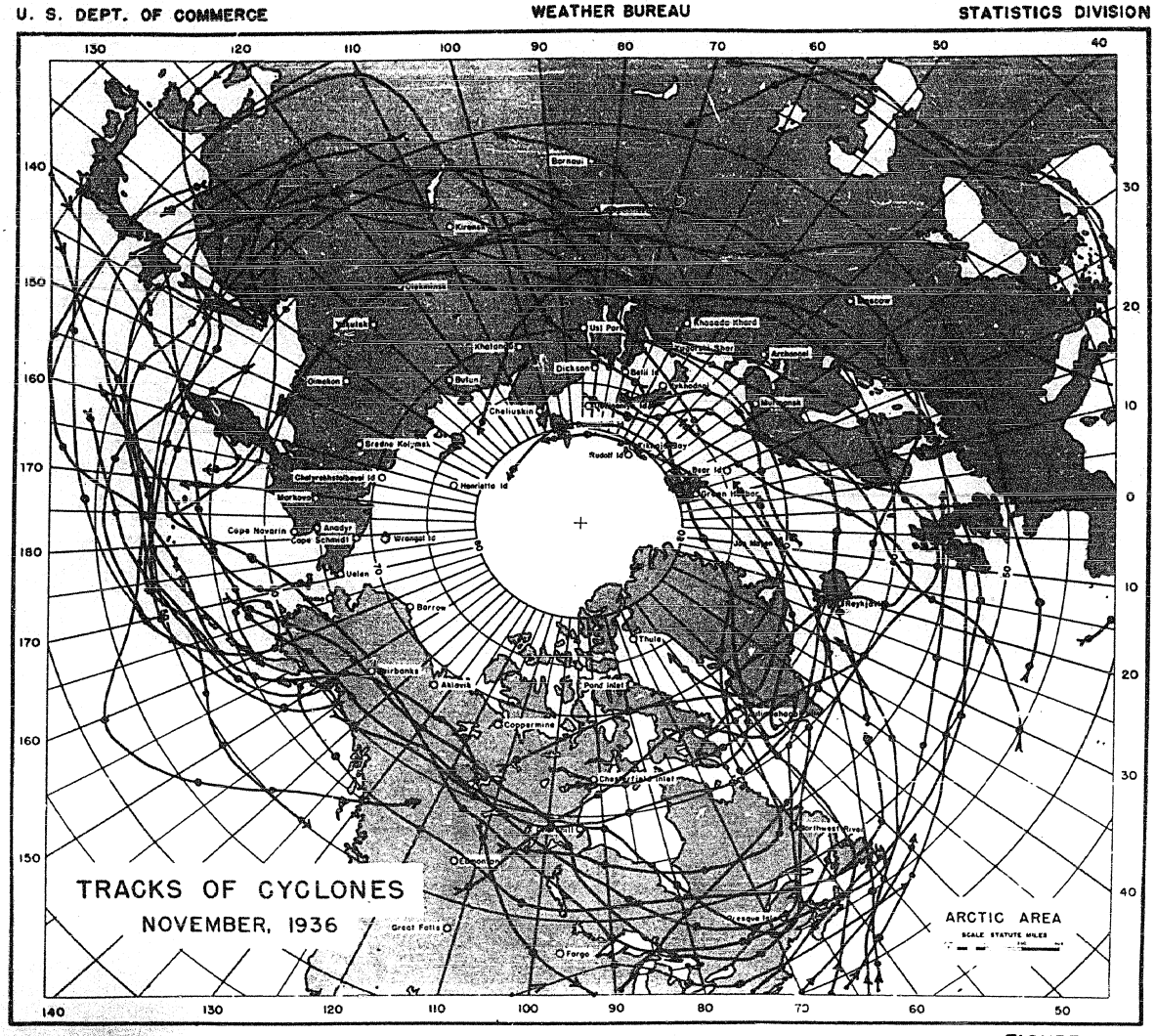

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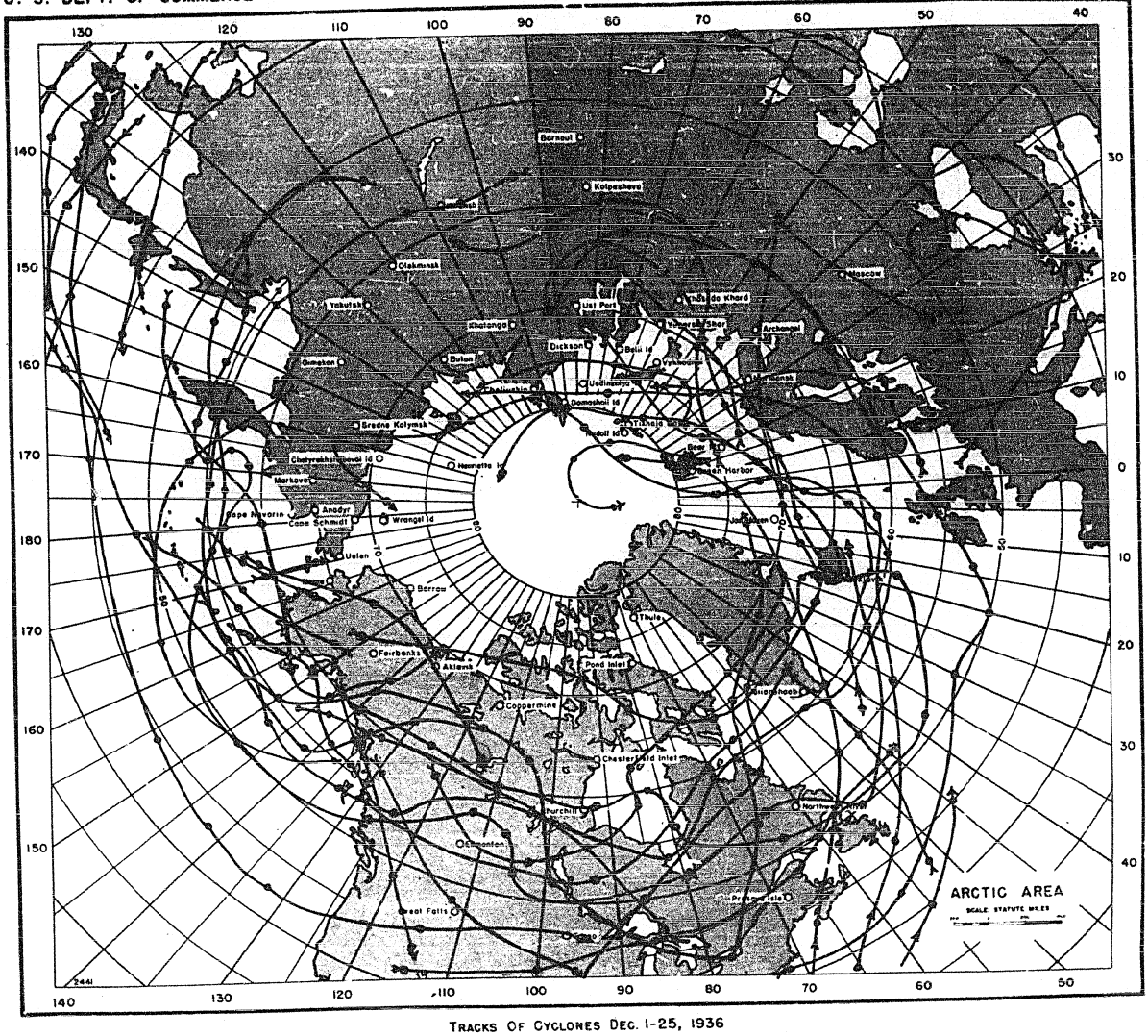

TRACKS OF CYCLONES DEC. 1-25, 1936

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TYPE MAPS

Since there are a large number of possible types of air mass distribution affecting the Arctic area, it would be impossible in a report of this type to cover, or even attempt to cover, the subject. A few maps were selected, however, for each season to indicate the general distribution of cyclones and anticyclones on a circum-global basis, and to illustrate the general idea of Arctic, Polar and Tropical, Continental and Maritime air, and the possible relative position of the same with respect to the Polar basin.

The source of these data is described in the section on storm tracks. The accuracy of the data is unquestioned, as careful checking and rechecking has been done to see that no discrepancies exist. Whenever the pressure situation is doubtful, the isobars are broken. Precipitation areas are shaded or indicated by triangular shower signs. Occasionally, precipitation occurs at isolated stations outside of the shaded areas. The temperatures and other data can, in most cases, be read with the aid of a magnifying glass.

The chart of March 7, 1931 (figure 24) shows a well developed mass of cA air over the Beaufort Sea, with an extension across the Polar basin to northeastern Siberia. This represents a spring type which would give excellent flying weather over the Great Falls-Fairbanks-Kirensk-Moscow route, very good conditions over the Aklavik-Bulun route, but poor flying conditions over the North Atlantic sector of either the north Greenland, or the south Greenland routes. The stable conditions over the Alaskan-Siberian routes would, perhaps, persist for a week, or even two or three weeks, with only slight local disturbances in the Moscow or Bering Sea regions. This represents about the best condition for any type of Arctic flying that could be found. The Arctic and Polar Fronts are well developed, but all of the bad weather is in middle latitudes or oceanic areas.

The chart of May 6, 1933 (figure 25) is attached to illustrate a common spring type where the center of high pressure has moved eastward from the Aklavik region to the Canadian Archipelago-Hudson Bay section. This gives the best condition for flight from the central U.S. via north Greenland to Spitzbergen and Moscow, or via Aklavik to eastern Siberia. Storm activity would impede flying across central Siberia, or across the Atlantic route via Iceland. In this case, as in the previous one, the Polar Front is well developed, with a nice series of waves or storms in middle latitudes all the way from Japan across the Pacific, the United States, the Atlantic and Europe to the longitude of Vienna. This series of storms along the Polar Front can keep up for several weeks giving an unusually large number of storms to middle latitudes, while the Polar regions will remain fairly free from storm activity.

The synoptic map for May 6, 1934 (figure 26), made exactly one year after the previous sample, shows a more northerly position for the Polar and Arctic Fronts and the reason one season can be so radically different from another at exactly the same time of the year. In this case the storms are encircling the globe, but moving into the Arctic Ocean north of Scandinavia and penetrating almost as far east as Bering Strait. In

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seasons like this the chances of getting through on any of the Arctic routes is diminished, but the best route would be the Fairbanks-Kirensk, or middle Siberian route because of the well developed continental high over the Rockies and the middle of Asia. Although the pressure in the Canadian Archipelago is much the same as on the May 6, 1933 map, the front in the Spitzbergen area would lie right along and across the path of the flight from north Greenland to Moscow, while the south Greenland route would be equally bad.

The May 10, 1935 chart (figure 27) is included to show a case where an anticyclone developed over the Polar Sea late in spring, gradually building up and spreading over the continents to give settled weather in northern America and Asia for a long period: from May 10 to 18. While the anticyclone is moving southward, the continents are under the influence of storm activity in the frontal zone, but after the narrow frontal belt has moved on south the flying weather is ideal throughout that section of the continent. Over all the continental areas the nights will be clear, air will be smooth until near noon when cloudiness builds up due to strong insolational heating. Fog is not apt to form in these cases as the air mass is too dry, and the nights are becoming progressively shorter and warmer, rather than longer and cooler as would be the case in August or September under identical pressure and air mass situations. In this case all of the routes would be good except the north Greenland, where bad weather would be encountered over the Barents Sea region. The storm belts are quite far south, indicating low zonal circulation or an unusually low latitude for the Arctic-Polar Front.

The chart of June 3, 1934 (figure 28) shows a cAK Polar high moving into central Siberia from the pack ice, later spreading out in central Asia to become a strong cP anticyclone. This is about as late in the season as one can expect anticyclonic weather over the continents. Weather will be good over the Aklavik-Bulun section, and thence into Moscow except right at Moscow where slight convergence would be attended by local storminess. In such a case the continental routes would be preferable to the oceanic, since bad weather at the terminal would be less serious if one had an alternate landing field along the route with good weather to allow the plane to await local improvement at the terminal.

The synoptic map of September 21, 1934 (figure 29) is an example of high zonal circulation, with strong development of the Polar anticyclone and a contrasting strong development of the Aleutian and Hudson Bay-Greenland cyclones. This high zonal circulation tends to improve weather conditions across the Arctic Ocean while deteriorating these in the continental regions. The best route in this case would be from the Mackenzie Valley across north Greenland or the Pole to Murmansk and Moscow. Flight via central Siberia would be slow or uncertain. During the week following this map a series of storms crossed Canada from Alaska to Greenland making flying conditions very bad in that area. This intense development of the Arctic anticyclone at this time of the year usually brings the first real winter and blizzard conditions to the continental sub-Arctic. Snow will cover the ground and temperatures will drop to 10° or 15° above zero. Rivers will begin to freeze over and snow may stay on the ground in sheltered regions for the rest of the winter. No better example of the development of the Arctic and Polar Fronts could be given, the Arctic Front lying in northern Canada and central Siberia, while the Polar Front circles a large sector of the hemisphere near the 40th parallel. The storminess and bad weather are a result

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of strong wave motion set up by the contrast between the extremely cold (for the season) Arctic air and the still warm oceanic and continental sub-Polar regions. This contrast continues later in the Maritime regions than in the continental, since this first cold outbreak tends to stabilize the land areas and reduce the contrast, while the water continues to be warm late in the fall. So after a fortnight the land routes should regain their status as the favored way for air transport, and this was actually the case.

The September 30, 1933 chart (figure 30) is an example of a weakly developed Arctic anticyclone with high zonal circulation. Except for the storm in the Norwegian and Barents Sea, the map could be considered typical of summer conditions over the Northern Hemisphere. A low in Alaska and the Hudson Bay region, with high pressure in the British Columbia and northeast Siberian sections is a frequent pressure set-up and sometimes persists for days or even weeks. The attending flying conditions are obvious: good flying weather over the western routes and unflyable weather over any route crossing the Spitzbergen or Norway areas, and in the Hudson Bay region. The stagnant low in Alaska, even when farther inland, does not seriously interfere with operations around Fairbanks unless a strong flow of cAK air pours in from the north or northeast with a stationary front in the Tanana-Yukon Valley, and this occasionally serious, but not frequent, situation usually comes in June or early July rather than in the late summer or fall. It should be mentioned that a weak front in the interior of Alaska or Canada does not usually interfere with flying operations since the general motion is downslope and most of the moisture has been precipitated on the Pacific side of the high Cordillera. The situation in central Siberia, however, is radically different. More moisture pours in through central Europe and Russia to the heart of the continent, so that even a weak front will cause messy weather where it strikes the higher ranges of northeast Siberia or the strong slope of the cA air mass moving into that region. So care should be taken in interpreting the presence of either fronts or weak lows as indicating poor operating conditions without first considering climatic and synoptic conditions attending those fronts.

The synoptic Northern Hemisphere chart of November 22, 1936 (figure 31) is one counterpart of the map of March 7, 1931 (figure 24) when flying weather was fairly good over the whole Arctic. In this case there would be difficulty encountered in flying any of the various Arctic routes. No single leg of any route is free from bad weather and all of the Atlantic routes are completely closed. Apparently the section from Aklavik to Bulun is anticyclonic, but monsoonal blizzard conditions along the East Siberian Sea eliminate that sector from consideration. The northern portion of the front just east of the Rockies in Canada would be flyable, and the southern portion should improve before the day is over. Conditions in central Siberia are generally bad. Gradients are so strong that intense interchange of air takes place between the cyclonic and anticyclonic areas, producing severe frontal activity and dangerously changeable weather even in areas where the current weather is good. Winds aloft will be of gale force over most of the area north of 50°, and these winds will be subject to great angular changes in short horizontal distance, making navigation by instrument doubly hazardous. Above 70° at that season the darkness is constant: cloudiness would obliterate any moonlight effect, so that all

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flying would need to be by instrument over the Polar basin. All in all the picture is discouraging, and such conditions could and did in this case, persist for weeks. There were only a few days from the middle of November until after the first of January when weather had improved appreciably over any large area of the Polar regions. The chart of December 18, 1936 (figure 32) shows one of those few days when a break had occurred which would allow flight over several sectors of the Arctic air routes.

The synoptic Northern Hemisphere chart of December 18, 1936 (figure 32) shows a very high zonal circulation, with the belt of storms far north of the usual course for so late in the season. The latitudinal and longitudinal temperature distribution in Asia was discussed in the section on Arctic air masses. The North Atlantic and Norwegian-Barents-Kara and Laptev Seas are under the influence of severe and widespread storm activity, and would be absolutely unflyable. Even the interior of Siberia, apparently under the influence of extensive anticyclonic development, would be difficult territory for flying due to local fogs in the intensely cold eastern areas, and much local cloudiness farther west in advance of the extended front which runs all the way from the Laptev Sea to the Black Sea, a distance of over 3,000 miles. On this map conditions are favorable for flying only over short non-continuous sections in the continental areas. No long distance flights would be possible in the Atlantic area, and only with exceptionally good facilities in the Alaska-Siberia sections should flight be attempted under such conditions. Over the entire Arctic with conditions as on the previous chart (November 22, 1934), less than 20% of the scheduled flights could be completed, while under conditions as shown on this map possibly 30% of the scheduled flights could be completed. On the other hand there are February, March, or June when 80% or 90% of the flights scheduled to begin at daybreak could be completed by dark over the entire Arctic and sub-Arctic portion of the globe.

It should be remembered that the present study covers only nine out of an infinite number of possible "types" of synoptic situations that could influence Arctic aviation for better or for worse. No two situations will be the same, and even the same apparent situation may persist a long time in one case and only a short time in another. While two storms can accidentally follow the same course, or travel at the same speed, the rule is for variety rather than similarity in paths, intensity, speed of movement, deepening, filling, and even distribution of fronts around low pressure centers.

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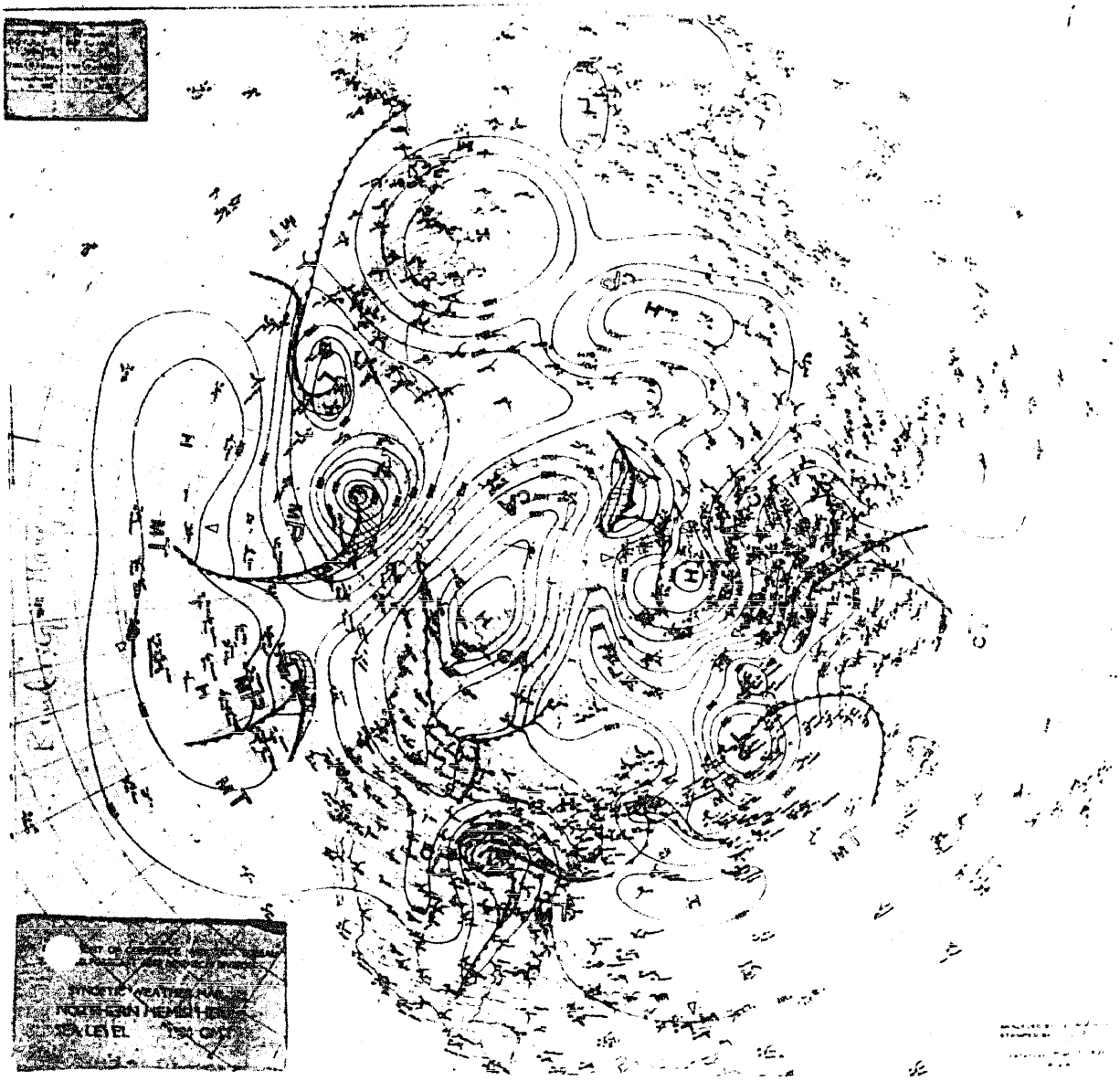

Figure 24

Synoptic Weather Map, Northern Hemisphere Sea Level

March 7, 1931

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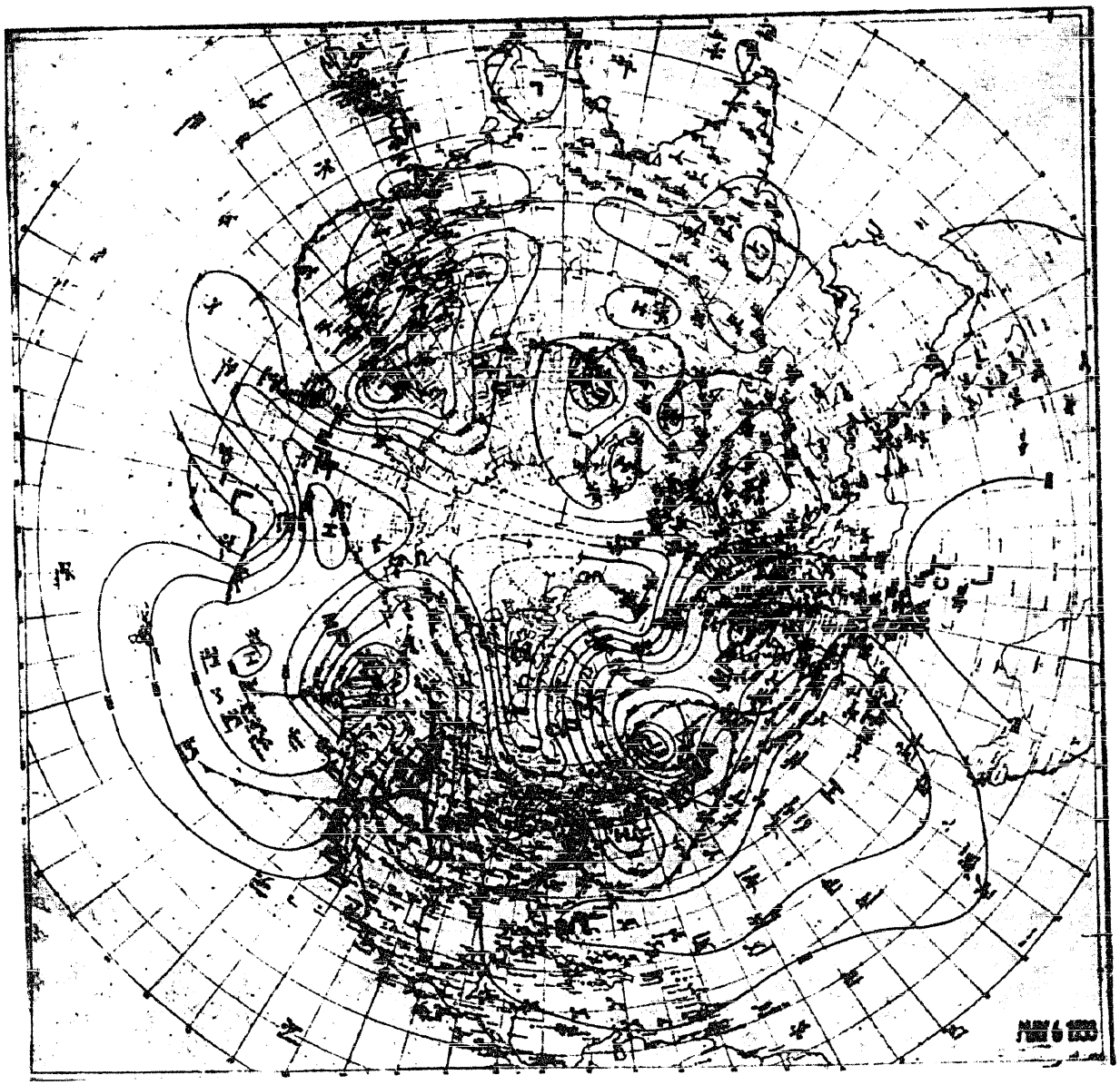

Figure 25

Synoptic Weather Map, Northern Hemisphere Sea Level

May 6, 1933

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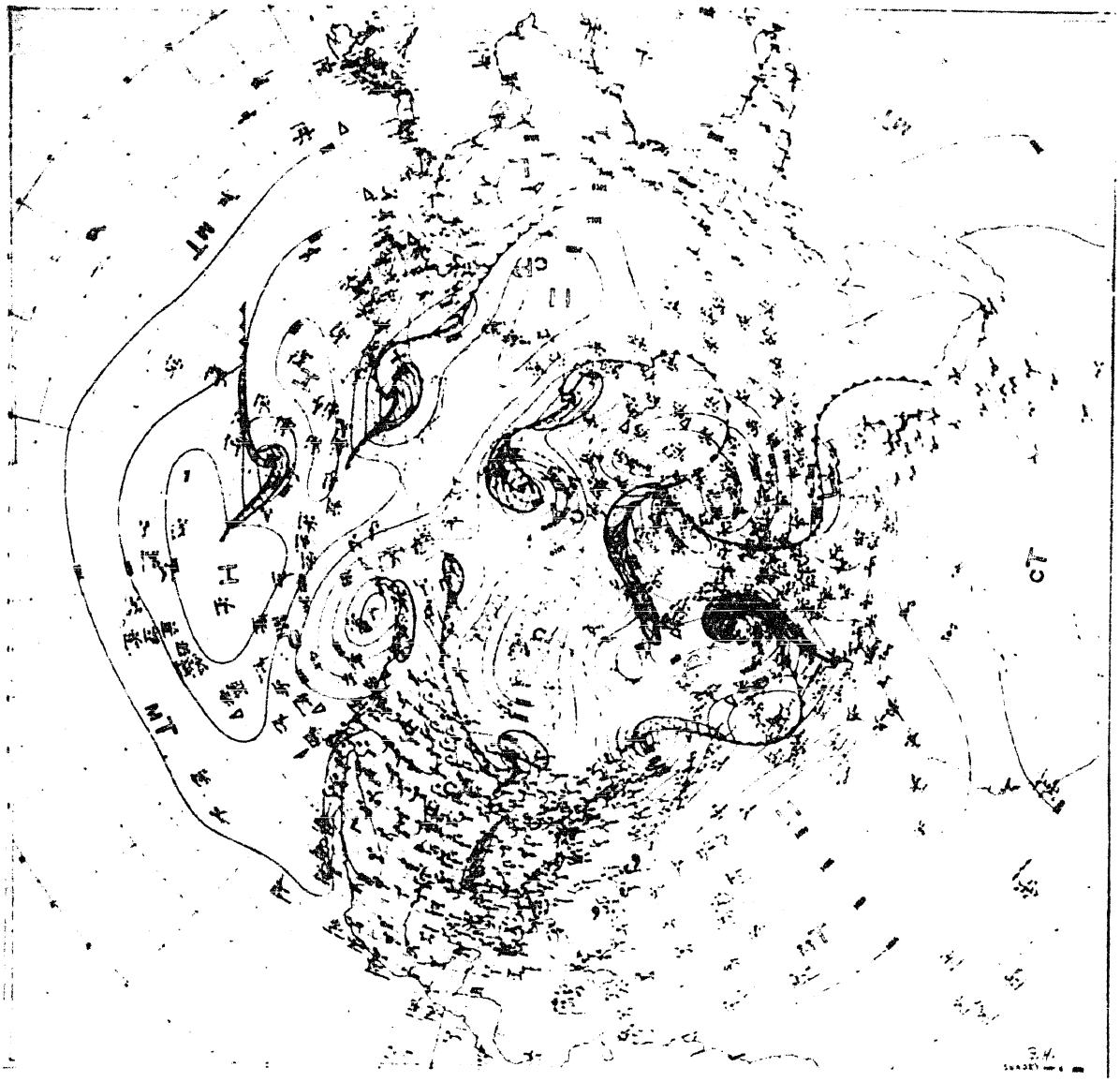

Figure 26

Synoptic Weather Map, Northern Hemisphere Sea Level

May 6, 1934

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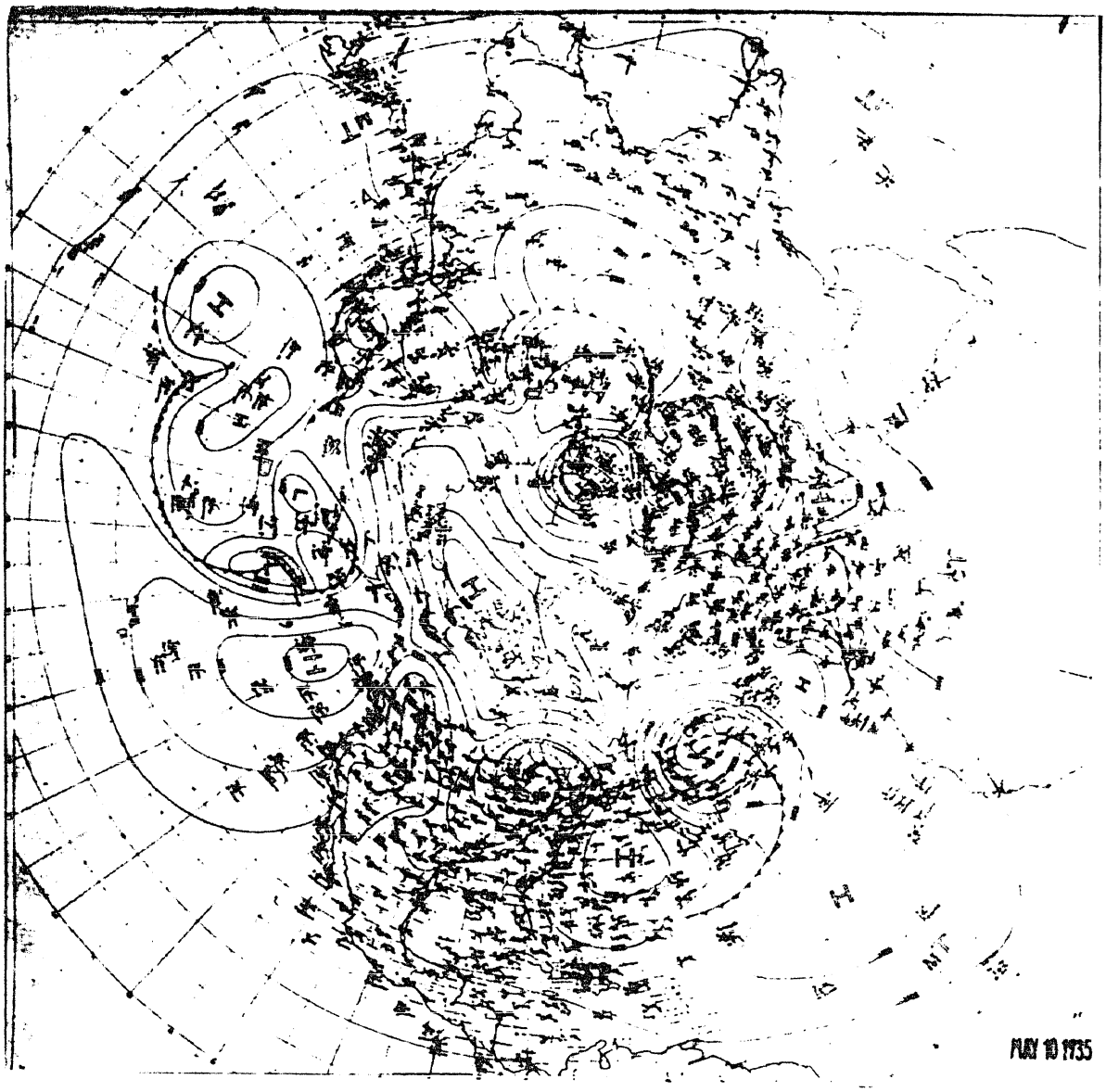

Figure 27

Synoptic Weather Map, Northern Hemisphere Sea Level

May 10, 1935

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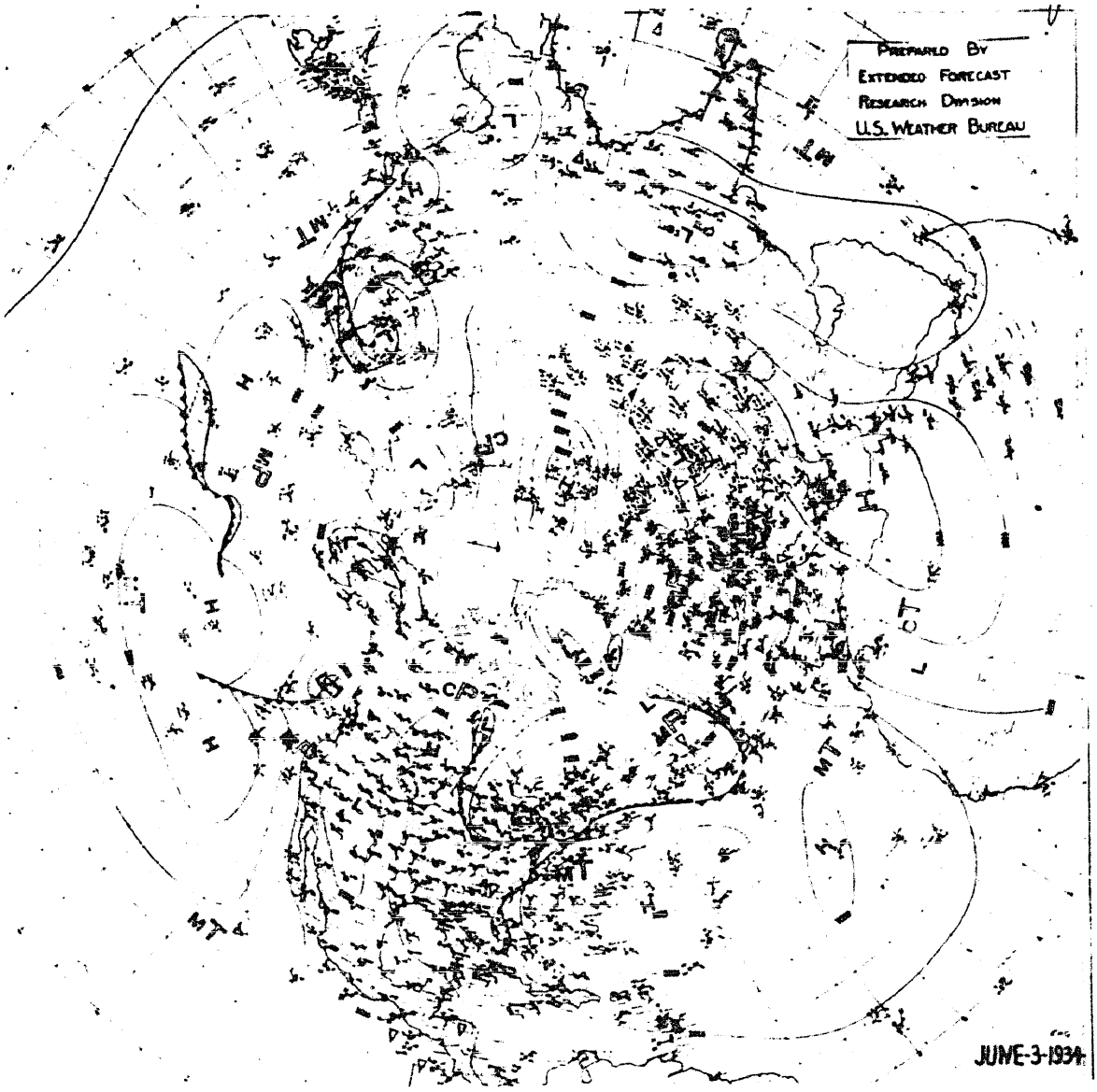

Figure 28

Synoptic Weather Map, Northern Hemisphere Sea Level

June 3, 1934

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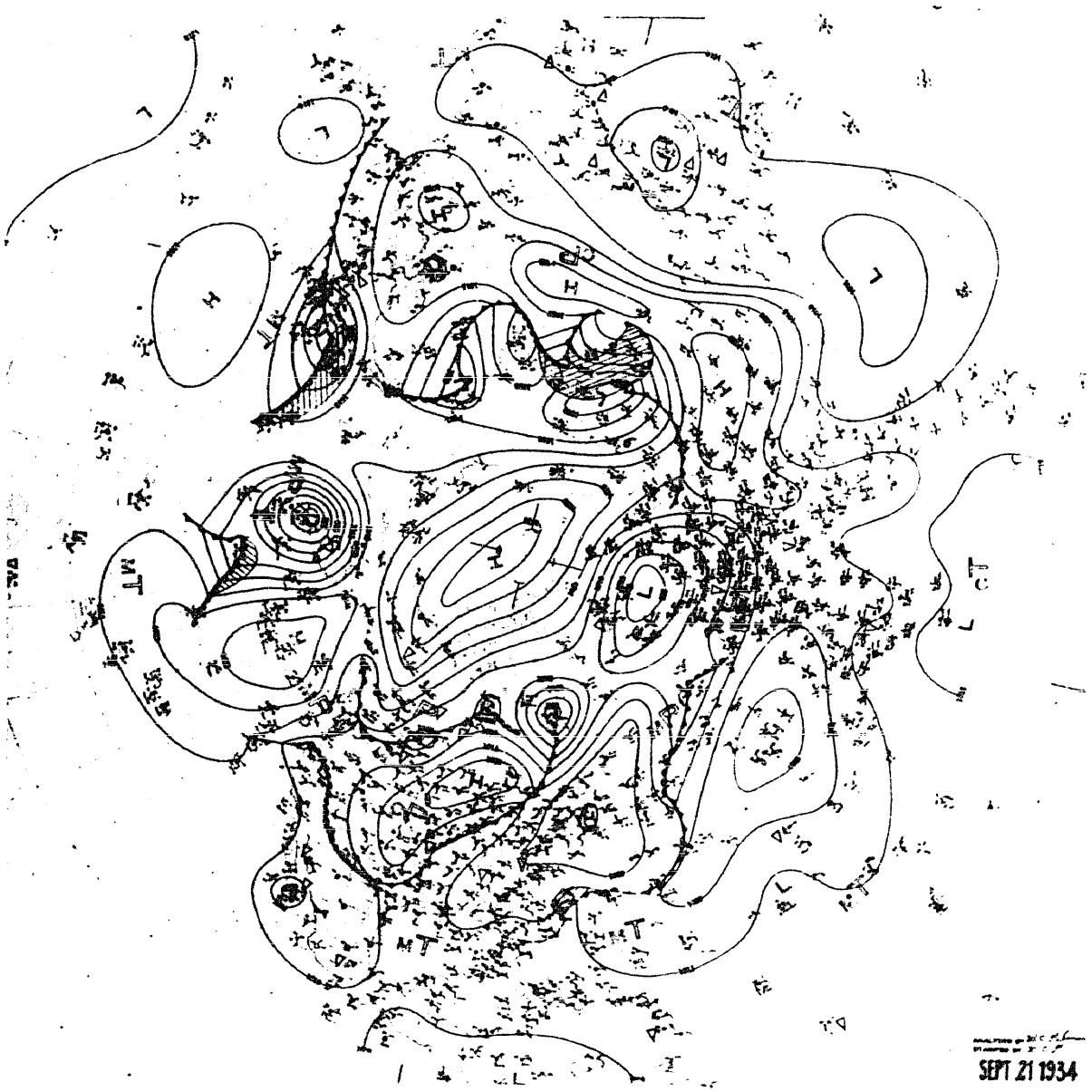

Figure 29

Synoptic Weather Map, Northern Hemisphere Sea Level

September 21, 1934

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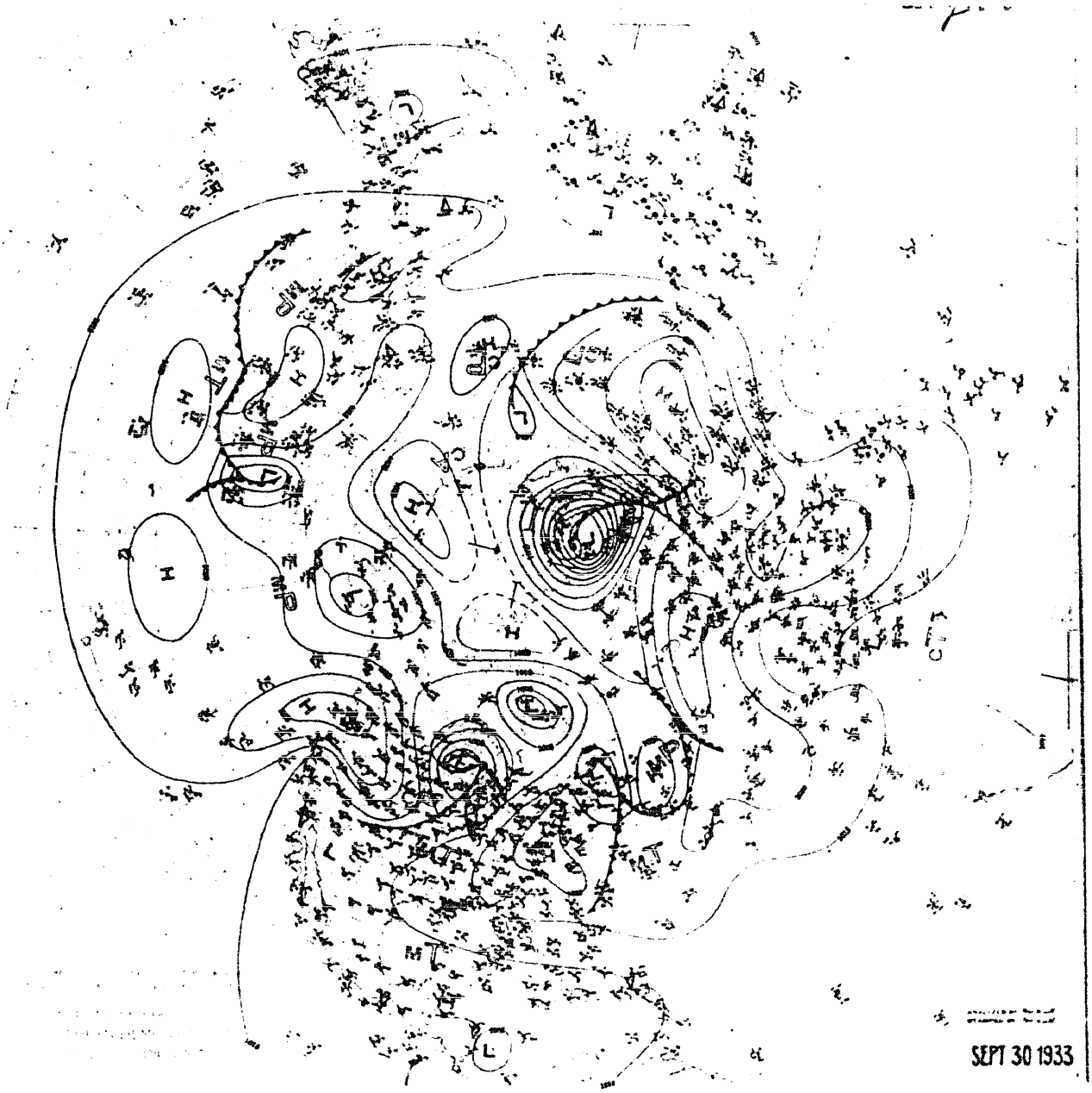

Figure 30

Synoptic Weather Map, Northern Hemisphere Sea Level

September 30, 1933

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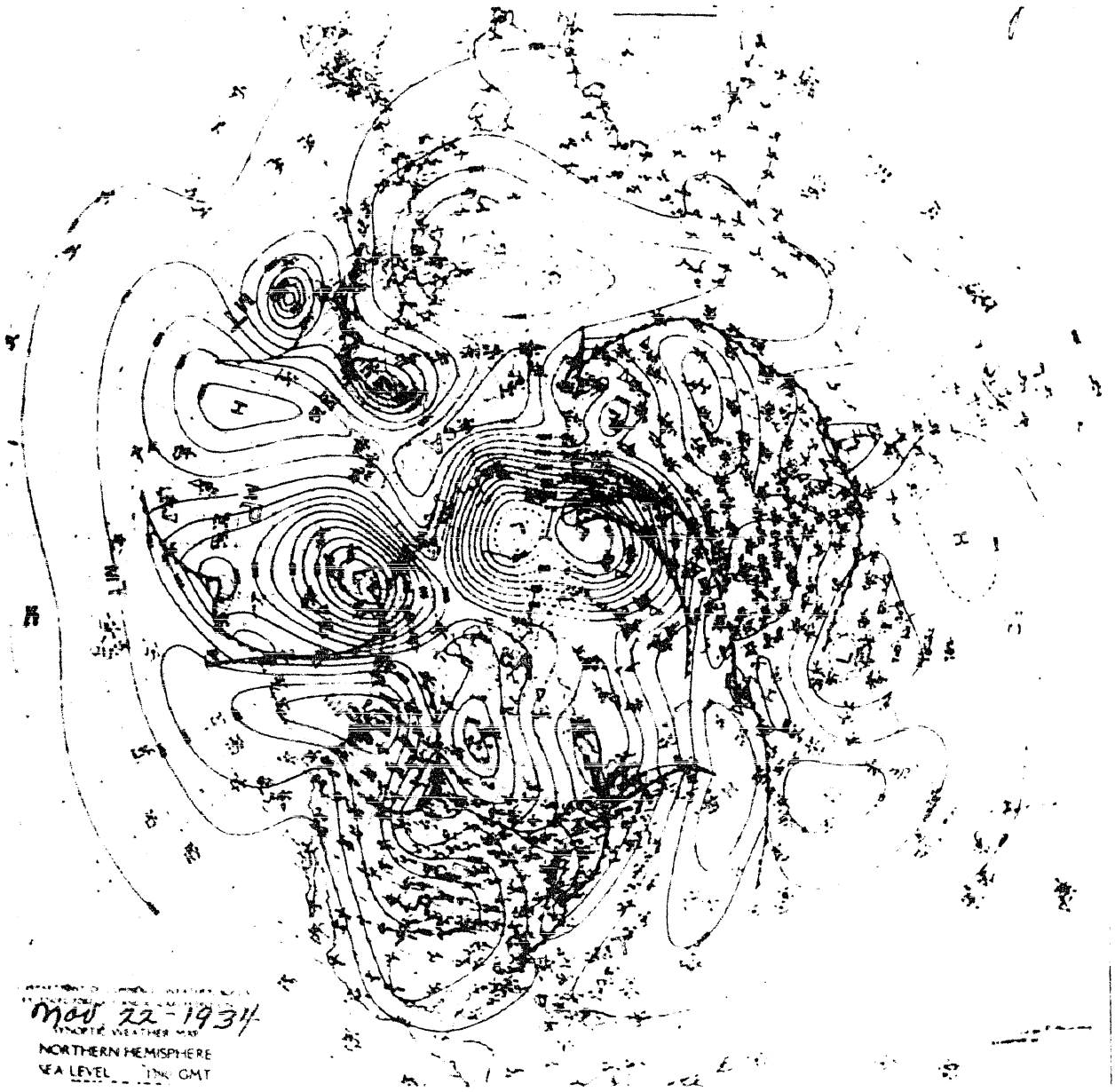

Figure 31

Synoptic Weather Map, Northern Hemisphere Sea Level

November 22, 1934

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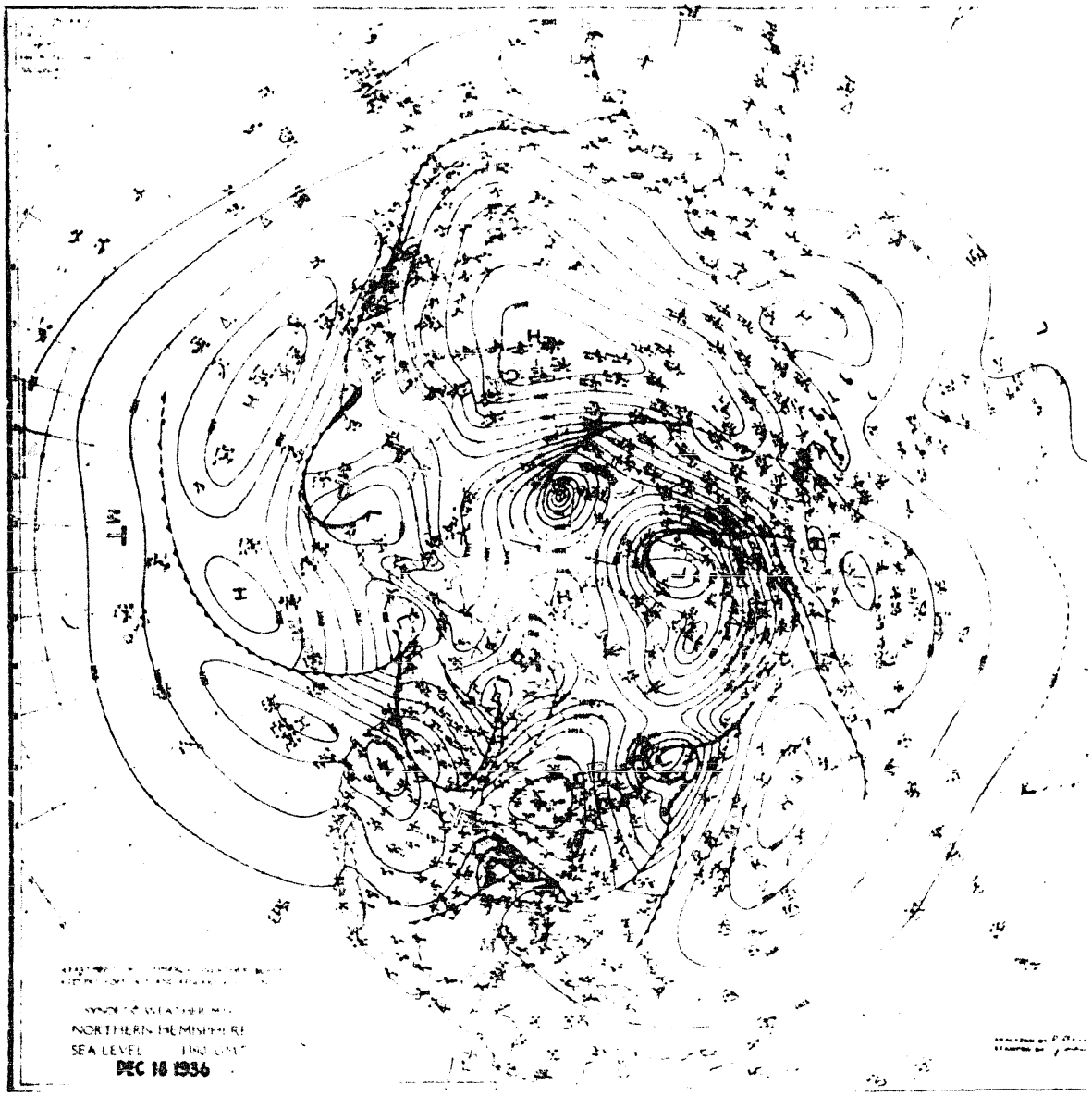

Figure 32

Synoptic Weather Map, Northern Hemisphere Sea Level

December 18, 1936

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WIND CIRCULATION OF THE POLAR REGION

From the limited data available, a generalized picture of the wind system of the Polar region can be constructed. Of primary importance is anticyclonic circulation in the Polar region. As little winds-aloft data are available for the region north of the 80th parallel, our conclusion about the upper-wind circulation in the Polar anticyclone can be based to a limited extent on the knowledge of the circulation in anticyclones of lower latitudes. The Polar anticyclone, as is the case with continental anticyclone of winter in lower latitudes, is dependent on a net loss of heat. However, in the case of the continental anticyclone of lower latitudes, sufficient insolation is received during the warmer half of the year to not only end its existence but even to replace it with low pressure. In the summer the Polar anticyclone is not destroyed but pressures are considerably reduced by the added insolation. During the long Polar winter little heat is received from the sun, also there is a continual loss of heat through radiation and as a result there is a piling up of cold heavy air. When a sufficient amount of air has accumulated at the Pole so that a balance no longer exists, a gradual flow of air out of this cold air dome takes place. While the direction of this outflowing air is at first from the north, it soon assumes an easterly component due to the rotation of the earth. Velocities associated with the central core of this Arctic air mass would be small. It is believed that the vertical extent of high pressure is not great in the Polar anticyclone and that above the first few kilometers the pressure field is probably reversed with low pressure present. If the above assertion is true, the motion of the air in the Polar anticyclone above the first few kilometers must be anticlockwise or westerly about the Pole, with a slight component in the direction of the Pole to compensate for the loss of air at the lowest levels.

While there is a more or less steady flow of air of this cold air dome, the process is greatly accelerated at times by the passage along its periphery of areas of low pressure which upset the balance and induce large masses of the cold air to break away from the parent mass and move out of the Polar region along certain well-defined continual paths. These periodic mass outbreaks of cold air are not limited to the lowest levels but embrace the entire troposphere, disrupting the shallow easterly circulation of the lower levels and also the westerly circulation above 6,000 feet. At times low pressure centers will invade the region usually occupied by the Polar anticyclone with attendant gales and stormy weather. Incursions such as these would be most numerous in the summer when the Polar anticyclone is weakest and at such times when the Polar anticyclone has been depleted by mass outbreaks of cold air into lower latitudes.

As was mentioned earlier, areas of low pressure pass along the periphery of the cold air mass and certain areas are zones of greatest frequency. One such zone lies along the Atlantic Arctic Front. In this zone there is no well-pronounced prevailing direction and winds are strong and variable. This front marks the mean southern boundary of the Arctic air mass. It extends from the vicinity of southern Greenland northeastward into the Barents Sea and beyond and changes its mean position with the progression of the seasons. Another such active region exists along the Pacific Arctic Front which extends from Alaska to eastern Siberia passing through the Bering Sea. In addition there are two regions with winds of monsoon character, one such region in Siberia and another in Alaska. Of local consequence

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are katabatic winds. These winds are caused by the downrush of cold air from higher elevations. The passage of a low may provide the necessary pressure gradient to set such winds in motion. These winds frequently reach gale force and if the area is snow covered the turbulent action of the strong wind will carry the snow dust aloft to such heights as to blot out the sun. Winds of this character can occur along the entire outer portion of the Arctic basin where there are elevations or mountains from which the cold air can sweep. They are known to occur along the deeply indented coast of Norway, at Wrangel Island, and in the Aleutians.

Local winds in the Alaska region are known as "williwaws," "takas," or "kniks," their strength being greatest in the months when the temperature contrast between the land areas and the open water is the largest. The critical velocity marking the beginning of sufficient turbulence to carry the snow dust aloft is about 11 m.p.h. At about 18 m.p.h. the turbulence is great enough to carry sufficient snow dust aloft to reduce the visibility to a point presenting a landing hazard to aircraft.

The first region to be discussed is that portion of Siberia east of the Verkhoyansk Mts. The wind system of this region is monsoonal in character. During the colder months from September through March, a ridge of high pressure is present over eastern Siberia and southerly winds prevail along the northern portion blowing out from the cold land surface toward the Arctic Sea. These southerly winds would be strongest along the north coastal areas while in the interior the winds would be light with long periods of calm.

For instance, at Verkhoyansk in the interior during February to May there is practically no surface wind and even in October and November the surface winds are light, while at Tiksi Bay on the coast the average wind velocity is about 12 m.p.h. except during March and April, when the average drops to between 6 and 7 m.p.h. At Verkhoyansk the frequency of gales is greatest during the months of June, July, and August with an average of 2 or 3 per month. During these months the thermal low pressure system is most developed over the interior. Along the coast the frequency of gales is least during these same summer months, Tiksi Bay having an average of 1 per month from April through September. During the colder months when the anticyclone is well developed over the continent there are no gales in the interior at Verkhoyansk, but during these same months at Tiksi Bay on the coast the frequency is greatest. From October through May there is an average of about 4 gales each month. At Verkhoyansk the monsoon character is also reflected in the winds aloft.

In the winter at 3,000 feet, 56% of the observed directions are south to southwest about 10 m.p.h., also at 10,000 feet that quadrant having the greatest percentage was south to southwest with 37%. Low pressure areas seldom invade this continental area of eastern Siberia because of the uninterrupted strength of the anticyclone. Any cyclonic activity is fairly well confined to the region between the Polar anticyclone and the ridge of high pressure in eastern Siberia. The passage of cyclones in the region referred to above would affect the wind system along the northern quadrant of the Siberian anticyclone. Northwest winds follow in the wake of these cyclones and this could account for the fact that of the observed winds at 10,000 feet at Verkhoyansk 19% are northwest.

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Above 10,000 feet there are not enough data to draw any conclusions but for the few observations practically all directions are represented. At 3,000 feet southerly winds are less predominant in spring, 30% are south to southwest, 11 m.p.h. There is a secondary direction of greatest frequency from the northeast to north-northeast of 25%. At 10,000 feet in spring 50% are from that 90° quadrant from south-southwest to west-northwest while 40% are from that 90° quadrant from north to east about 12 m.p.h. At this elevation those winds having the least frequency are those with a southeasterly component. Summer is the only season which brings a reversal of the wind flow; at that season the thermal low develops over the interior and winds become northerly at Verkhoyansk.

At 3,000 feet 30% are north-northeast to east-northeast with a secondary maximum of frequency from south-southwest to west-southwest. At 10,000 feet, however, 55% prevail from the northwest to northeast and at 20,000 feet 64% are west to north. The great depth of the northerly current in summer is no doubt dependent upon the fact that at that season Verkhoyansk is located along the pressure gradient between the relatively high pressure of the Polar region and the low pressure of the Asiatic Continent. Autumn again brings southwesterly winds at 3,000 feet with 55% south-southwest to west. A gradual veering of the wind takes place with elevation and at 10,000 feet 46% of the observed winds are from southwest to west-northwest 14 m.p.h.

Bering Strait and the land areas immediately to the east and west being low in elevation present no obstacle to the free interchange of air between the Arctic and the region of the Bering Sea. During the winter there is a prevailing northerly wind through this region. This northerly flow of cold air replenishes the air lost through the flow of air from the Bering Sea into the Pacific Ocean during the winter season at which time the Aleutian Low is well pronounced. The surface winds and upper winds at Nome, Alaska, confirm this. Sixty percent of the surface winds at Nome are from north to east-northeast about 10 m.p.h. and continue from that quadrant up to 6,000 feet. At 10,000 to 13,000 feet the winds back to a northerly quadrant and about 50% are from that direction with an average velocity of 24 m.p.h. Autumn winds at Nome are similar to those in winter with 64% of the surface winds from the quadrant between north-northwest and east-northeast averaging 8 m.p.h. At 10,000 feet 55% of the winds fall in that segment between north and northeast with an average velocity of 21 m.p.h. However, in spring and summer when the Aleutian pressure system is less pronounced and farthest south, there is no such marked prevalence in direction aloft as there is in fall and winter. It can be said that there is a noticeable absence of southerly winds at 10,000 to 13,000 feet, all other directions being represented.

The wind regime of Alaska like that of eastern Siberia is to some extent monsoonal in character. In the warmest months a thermal low develops over the interior of Alaska whereas in winter high pressures are present. As a result winter winds at Fairbanks are regulated by the Alaskan and Polar high pressure systems and by the proximity of the Aleutian low pressure system to the south. Surface winds at Fairbanks are light as that city is located in a sheltered valley. The average winter surface velocity is between 4 and 5 m.p.h.

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Immediately above the surface at 1,500 feet 71% are east-northeast to east-southeast, 13 m.p.h., with increasing height there is a veering of the wind and at 10,000 feet 43% are south to west-southwest, 21 m.p.h. At 13,000 feet winds from the south to northwest at 22 m.p.h. have the greatest frequency.

Winds of spring at Fairbanks like those of winter veer from the southeast, 14 m.p.h., at 3,000 feet to southwest, 19 m.p.h., at 13,000 feet. This would indicate that whereas the low pressure at the surface is centered to the southwest of Fairbanks, at 13,000 feet the lower pressures are found to the northwest.

In summer high pressures replace the low pressures of winter in the Gulf of Alaska and the warmed Alaska interior produces a thermal low. The net result produces decreasing pressures across Alaska toward the north. The pressure system also does not change as much with elevation as at other seasons. Consequently there is no great turning of the wind with increasing elevation. Prevailing winds at Fairbanks in summer, therefore, are southwesterly about 16 m.p.h. at all levels. This is slightly less than the average at other seasons.

The progression from summer to autumn brings the greatest change at the 3,000-foot level with a shift of the prevailing wind direction from southwest to southeast and a slight increase in velocity from 14 m.p.h. in summer to 17 m.p.h. in autumn. There is practically no change in direction in the 6,000- to 13,000-foot layer and a slight increase in velocity from 16 to 20 m.p.h. for the prevailing southwesterly wind. It can be said that the greatest seasonal variation in the wind at Fairbanks takes place below 6,000 feet with little change above that level. This would indicate mean surface pressure changes from season to season, although well pronounced, are not reflected to any height and that the relative pressure distribution above 6,000 feet is rather constant throughout the year.

Barrow winter winds are almost entirely dominated by the Polar anticyclone. Northeast to east winds prevail up to at least 13,000 feet. However, the frequency percentage decreases with height from 48% at the surface to 30% at 13,000 feet. The average surface velocity is 14 m.p.h. and from 3,000 to 13,000 feet, the average velocity remains about 27 m.p.h. for these east to northeast winds. The change from winter to spring causes the winds aloft at Barrow to veer about 22° with little change in surface wind direction. The velocity likewise does not vary greatly from winter to spring except that whereas in winter there is slight increase in velocity for the prevailing direction from 25 m.p.h. at 3,000 feet to 29 m.p.h. at 10,000 feet there is a slight decrease in the velocity with elevation in spring. Summer brings the greatest departure from the Polar anticyclonic wind pattern at Barrow; at the surface easterly winds still prevail but a secondary maximum of greatest frequency exists from the west to southwest. Aloft the direction of greatest frequency becomes southwest to west from 3,000 to 10,000 feet and at 13,000 feet there is no particular quadrant of greatest frequency but by far the greatest percentage of wind has a westerly component. At 13,000 feet those winds which have the greatest westerly component are strongest about 22 m.p.h. while easterly winds have the smallest velocity. Easterly winds are again predominant in the fall with

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58% of the surface wind from the east-northeast to southeast 16 m.p.h. At 3,000 and 6,000 feet those winds having the greatest frequency, accounting for 45% of the total were from east-northeast to southeast with an average velocity of 24 m.p.h. At 10,000 feet the dominance of easterly wind is less pronounced while at 13,000 feet there is a small weight of prevalence in favor of west to northwest winds, 21 m.p.h.

The frequency of gales in Alaska is similar to that of eastern Siberia. In the interior the season of greatest frequency is summer. Along the coast the season of greatest frequency is winter. Coastal stations have a greater annual frequency as compared to inland stations. Barrow on the north coast has an average of 18.7 gales per annum while Fairbanks in the interior has an average of 0.9. Wrangel Island has an annual average of 50.4 gales. From May through August the monthly average is 2. The season of low average at Wrangel Island is associated with the summer at which time the Polar anticyclone is weakest and the Aleutian Low is dissipated. During the colder months from September to April the average monthly frequency is between 5 and 6. At this season the Polar anticyclone is present and the Aleutian Low is well developed.

Little is known of the upper-wind regime of northern Canada. The elevation of the many islands of the archipelago is not great. The area is ice and snow covered a great portion of the year. An extension of the Polar anticyclone extends down over this region. A steady flow of air out of this high pressure area continues throughout most of the year being greatest in winter when the Polar anticyclone is most developed. Winds across the Hudson Bay region as a result are northwesterly in winter. The depth of this northwesterly current in winter is reflected in the winds aloft at Port Harrison. Northwesterly winds are most frequent up to the limit of observational data at 13,000 feet. Progressing from winter to summer the Polar anticyclone and its Canadian extension gradually weaken and as a result the northwesterly winds do not penetrate as far south as Port Harrison on the surface. Aloft however there is still a prevalence of northwesterly wind at 6,000 to 13,000 feet but the velocities are not as great. There are no data as to the number of gales in this region. In the colder months of the year during the presence of high pressure gales would be few. In the warmer months of the year the weakened anticyclone would allow cyclones to invade this region with attendant gales.

The ice-covered region of Greenland, because of its high elevation and great size, exerts a considerable influence on the wind flow in its vicinity. The wind circulation in close proximity resembles that of an anticyclone. At Etah in northwest Greenland during the winter from the surface to 3,000 feet the prevailing winds are east to northeast flowing down from the ice cap. Between 6,000 and 13,000 feet there is a shift to south and southeast, the circulation in relation to the island now resembling that about an anticyclone. This same circulation scheme of winds off the ice cap at low levels with south to southeast winds above 6,000 feet holds true for spring and summer. In autumn the prevalence of air flow from the northeast continues up to 10,000 feet and at 13,000 feet becomes northwest to north.

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The wind scheme at Mount Evans is similar to that at Etah as both are on the western side of Greenland. The lowest level of air at Mount Evans has an easterly component coming from the ice cap. Above 3,000 feet for all seasons the wind assumes a southerly component. A short summer record of winds-aloft data was obtained at a station on the ice cap in central Greenland. At this season the region of highest pressure in the Arctic is located off the northwest coast of Greenland and low pressure to the east at Baffin Island. On the surface of the ice cap as a consequence, 70% of the wind is from the east-northeast to south-southeast. This prevalence of easterly wind continues above the ice cap to a depth of at least 17,000 feet. Too much reliability cannot be placed on the record because of its shortness. At East Station on the east coast of Greenland there is a high percentage of calm at the surface, a maximum in the summer of 88% and a minimum in the autumn of 26%. The remaining time, light easterly winds persist. Immediately above the surface layer, a northwesterly wind prevails and the analogy of Greenland's wind system to that of an anticyclone is again demonstrated.

Reykjavik, Iceland, off the southeast coast of Greenland is in a region of cyclogenesis and the wind regime would be a variable one. During the winter Reykjavik is in the central portion of the statistical low pressure system. Southeasterly winds prevail in the first 3,000 feet of atmosphere. At 6,000 feet there is no prevailing wind and at 10,000 and 13,000 feet westerly winds prevail. In the spring this statistical low has moved eastward and decreased in intensity and the prevailing wind at Reykjavik is northwesterly. Above the surface easterly winds prevail up to 10,000 feet and at 13,000 feet northerly winds prevail. In the summer the pressure in the Arctic anticyclone is highest to the northeast of Greenland and the prevalence of the deep current of northerly wind in evidence at East Station in Greenland extends eastward as far as Reykjavik. This current of north wind exists from the surface up to at least 13,000 feet. Likewise in autumn northerly winds prevail from 3,000 to 13,000 feet.

Observations made during the Nordic 1937 Expedition to northwest Greenland and to the Canadian Arctic in 1938 confirm other observational data to the effect that the highest wind velocities are found at or immediately below the tropopause. The height of the tropopause for one observation was found at 36,750 feet while the maximum wind velocity occurred at 32,150 feet. The maximum velocity at this elevation was 34 m.p.h. The height of the maximum wind velocity and likewise the height of the tropopause was found to vary with the surface pressure. During the presence of low pressure areas the maximum velocity occurred at lower elevations or at 26,250 feet to 31,150 feet and in high pressure areas at 32,800 feet to 37,750 feet. In comparison with data collected at other seasons the maximum velocities are found to occur about 10,000 feet lower in the winter than in the summer.

A comparison of the winds-aloft regimes at Tikhaja in Franz Joseph Land and at Tromso, Norway, affords a good example of the widely different systems that exist on either side of the Atlantic Arctic Front. Tikhaja near the 80th parallel lies to the north of the front and its wind system is largely governed by the Arctic anticyclone. Tromso on the 70th parallel lies south of the front and its wind circulation is governed by the Icelandic Low. However, the wind system at Tikhaja is also influenced by

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the Icelandic Low. Northeasterly winds are prevalent up to 13,000 feet at Tikhaja for all seasons except summer. In summer at the surface 32% of the time it is calm and 34% of the time the winds are north to east. Above the surface layer in summer there is no marked prevalence from any direction. The Icelandic low pressure system is practically nonexistent in the summer and the Polar anticyclone is weak. For all seasons at Tromso, south of the front, there is a prevalence of southerly wind shifting to southwesterly above 3,000 feet and extending up to 10,000 feet. At 13,000 feet there is no direction of greatest frequency. Velocities from 1,600 to 10,000 feet are slightly higher at Tikhaja, the average between 12 and 18 m.p.h. while at Tromso averages are from 10 to 18 m.p.h. At 13,000 feet the average is slightly higher at Tromso.

In the winter the surface winds at Dickson Island prevail from the south with a secondary maximum from the northeast. This would seem to indicate a conflict between the outflow from the continental anticyclone and the Polar anticyclone. At no great distance above the surface the air flow is largely from the northeast and remains in that quadrant up to at least 13,000 feet. During the spring months the prevailing winds aloft are easterly. In the summer surface winds are northerly and flow into the heat low of the continent but above 1,600 feet and continuing up to 13,000 feet the prevailing winds are southerly. During autumn there is a return of easterly winds aloft. The average wind velocities aloft are greatest in summer, from 16 to 22 m.p.h. while velocities in winter range from 14 to 16 m.p.h. Surface wind velocities are greatest in winter and the average monthly occurrence of gales is likewise highest. The average number of gales for the winter months is 9, for the summer 3, and for the year 80.

A summary of the winds-aloft data gathered on the Norwegian North Polar Expedition with the "Maud" follows. The data were gathered in the years 1918-1925 between latitudes 77° 33' N. and 70° 43' N. and between longitudes 105° 40' E. and 175° 15' W.

For all seasons combined surface winds showed the greatest frequency from northeast to southeast with 51% of all observed winds from that quadrant, the average velocity of these prevalent winds being 9 m.p.h. At 3,000 feet all wind directions are about equally represented except for north and northwest which have about half the percentage of other directions. The velocities as well as the prevalence is least for these north and northwest winds being 16 m.p.h. while southeast has the greatest velocity, 19 m.p.h. At 6,000 feet the picture is similar to that at 3,000 feet except that westerly winds have a slight edge in percentage. At 13,000 feet the weight of prevalence of west and southwest wind increases but all other directions are still well represented. Velocities at this level are now least for southeast being 17 m.p.h. and greatest, 22 m.p.h. for west. At 20,000 feet the weight of prevalence of west and southwest increases with a combined percentage of 33, southeast is least with 5% while all other directions have an average value of 11% individually. Velocities at 20,000 feet are greatest for west and northwest, 25 m.p.h. and least, for southeast, 19 m.p.h.

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From an average surface velocity of 7.8 m.p.h. there is a sharp increase to 17.4 m.p.h. at 3,000 feet above sea level. From 3,000 to 26,000 feet the rate of increase while at first very small becomes progressively greater and at 26,000 feet the highest average velocity is reached, 34 m.p.h. The upper limit of the troposphere is also found at about 26,000 feet and is evidently associated with the maximum wind. Average velocities at all elevations are greater in the winter as compared to summer. The average difference between the two seasons being 2.5 m.p.h. At 16,000 feet the difference is greatest, 6.3 m.p.h., and at 23,000 feet the difference is least 1.6 m.p.h.

In conclusion, there are certain factors that should be considered in regard to the evaluation of the wind regime of any region. As is well known there are shifts in the climatic scheme of the earth. As a rule these shifts are relatively small but in some years they are large and affect the climate of a region materially. These larger climatic shifts may amount to as much as several hundred miles so that the average seasonal temperature at a given point may equal that usually experienced at a point several hundred miles to the north or south. Naturally any climatic shift involves the wind system of a given region. The degree of change in the wind system may be so great that the wind system of one year would differ widely from that of another. Such climatic shifts do occur along the margins of the Arctic basin. The desirability of long observational records is thus demonstrated to give increasing value to a statistical study of climatological data.

Another factor affecting the representativeness of wind data is the cloudiness factor associated with wind direction. In certain areas of the Arctic, winds from one direction will bring clear skies and as a consequence winds-aloft data gathered at such times will extend to high altitudes. Winds from other quadrants will bring low cloudiness and observations will be limited. Some of the conclusions set forth in this discussion of the Arctic wind scheme have been based on records of short duration and weighted in favor of those winds associated with clear skies. These conclusions err in proportion to the unrepresentativeness of the data. However it is believed that the data was representative to such a degree that the conclusions set forth do approximate the actual conditions.

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Table 24

Average Number of Gales per Month and Year for the Polar and Contiguous Regions

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Anadyr	3.9	4.0	2.9	1.6	0.6	0.1	0.9	0.8	0.9	1.9	2.9	2.1	22.6
Archangel	2.4	1.6	1.6	1.3	1.8	1.6	0.7	1.1	1.9	1.8	2.4	1.5	19.7
Barrow	2.2	0.6	0.4	0.8	1.0	0.0	1.2	1.0	2.4	4.8	2.8	1.5	18.7
Bulun	0.3	0.5	0.4	0.6	0.2	0.2	0.1	0.2	0.4	0.5	0.5	0.2	4.1
Cape Cholyuskin	5.0	5.0	1.0	0.0	2.0	1.0	3.0	5.0	0.0	6.0	6.0	4.0	38.0
Dickson Is.	11.0	9.0	10.0	7.0	6.0	3.0	3.0	4.0	4.0	7.0	8.0	8.0	80.0
Domashnii	3.0	4.0	3.0	3.0	1.0	2.0	1.0	4.0	4.0	3.0	3.0	2.0	33.0
Dudinka	7.0	8.0	7.0	9.0	8.0	5.0	6.0	5.0	5.0	8.0	7.0	7.0	82.0
Fairbanks	0.5	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.9
Fram	3.2	3.2	4.0	1.8	1.2	0.5	0.0	0.0	1.0	1.9	2.3	1.3	20.4
Green Harbor	1.0	0.6	1.0	0.4	0.3	0.3	0.0	0.3	0.7	2.0	0.6	1.0	8.0
Inari	6.0	5.0	5.0	5.0	5.0	6.0	4.0	3.0	5.0	5.0	3.0	5.0	57.0
Jan Mayen Is.	5.2	4.2	3.6	3.4	2.1	0.7	0.2	0.2	2.0	2.8	4.5	4.0	32.9
Khatanga	0.0	0.0	0.0	2.0	0.0	1.0	4.0	1.0	6.0	0.0	2.0	0.0	16.0
Kirensk	0.9	0.2	1.3	0.2	1.0	0.8	0.8	0.2	0.1	0.3	0.2	0.5	6.5
Kola	4.0	4.0	4.0	2.0	3.0	2.0	2.0	1.0	2.0	3.0	5.0	4.0	36.0
Lyakhovski Is.	1.4	1.6	1.1	0.5	1.1	0.7	0.5	0.3	1.6	1.7	1.2	1.2	12.9
Markovo	0.8	1.3	1.4	0.7	0.3	0.8	0.4	0.7	1.2	0.7	1.5	1.7	11.5
Nanortalik	2.7	2.0	1.9	1.1	0.6	0.4	0.2	0.2	1.7	2.0	1.6	2.0	16.4
Nizhne Kolymsk	0.6	0.4	0.8	0.8	0.8	0.8	0.4	1.5	1.0	0.0	0.0	1.0	8.1
Nome	3.8	2.1	2.7	2.6	0.6	0.1	0.3	0.8	1.0	1.6	1.4	3.6	20.6
Obdorsk	3.0	4.0	6.0	5.0	6.0	7.0	4.0	4.0	5.0	5.0	4.0	5.0	58.0
Okhotsk	0.0	1.0	1.0	1.0	1.0	*	1.0	1.0	4.0	3.0	1.0	1.0	15.0
Olekminsk	0.0	*	1.0	*	1.0	1.0	2.0	*	1.0	*	*	0.0	5.0
Reykjavik	3.0	2.0	1.0	1.0	*	*	0.0	*	*	1.0	2.0	3.0	13.0
Russkoe	*	*	2.0	1.0	1.0	2.0	2.0	2.0	1.0	2.0	1.0	1.0	15.0
Sagastyr	1.6	0.7	0.0	0.4	1.4	1.4	3.0	0.7	0.5	2.2	1.8	1.0	14.7
St. Paul Is.	12.6	10.1	7.2	4.8	3.0	1.2	0.2	1.2	5.6	7.2	10.5	10.4	74.0
Srednc Kolymsk	0.0	0.0	*	0.0	*	1.0	1.0	1.0	*	1.0	0.0	0.0	4.0
Tiksi Bay	7.0	4.9	2.1	0.4	1.4	1.0	1.1	0.7	1.0	3.0	3.6	2.3	28.8
Treurenberg	7.0	4.0	2.0	0.0	2.0	1.0	2.0	0.0	4.0	6.0	7.0	4.0	39.0
Tromso	2.0	2.0	1.0	0.4	0.2	0.1	0.0	0.2	0.2	0.9	2.0	1.0	10.0
Trondheim	5.3	4.5	4.9	3.3	2.4	1.2	1.6	1.6	3.4	3.5	5.0	6.1	42.8
Turukhansk	1.0	*	1.0	0.0	*	1.0	1.0	0.0	0.0	0.0	0.0	*	4.0
Uelen	5.2	2.9	2.3	2.7	2.0	1.4	5.8	5.7	6.0	5.7	6.3	4.6	50.7
Ust Port	5.0	5.0	7.0	6.0	4.0	2.0	2.0	4.0	3.0	6.0	7.0	7.0	58.0
Vaigach	5.0	5.0	5.0	4.0	4.0	3.0	2.0	2.0	2.0	5.0	6.0	6.0	49.0
Vardo	6.0	6.0	6.0	3.0	2.0	2.0	0.5	1.0	3.0	4.0	5.0	6.0	44.0
Verkhoyansk	0.0	0.0	*	1.0	1.0	3.0	2.0	2.0	1.0	*	0.0	0.0	10.0
Viliuisk	0.1	0.6	0.6	0.6	0.8	0.9	1.1	0.9	0.4	0.4	0.2	0.1	6.7
Wrangel Is.	7.9	5.8	3.0	4.0	2.3	1.4	2.6	2.1	4.8	4.8	5.0	6.7	50.4
Yugorski Str.	7.0	6.0	6.0	5.0	4.0	2.0	1.0	1.0	3.0	5.0	7.0	7.0	54.0

*Less than one gale.

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Table 25

Average Surface Wind Velocity and Direction

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year
Anadyr	13.0	13.9	12.1	10.5	9.4	9.2	11.9	11.2	10.7	12.1	13.2	12.8	11.7
Archangel	11.9 SE	9.5 SE	10.6 SE	9.0 SE	10.2 NW	10.4 NW	8.7 NW	9.5 NW	10.7 SW	11.3 SW	12.4 SW	9.7 SE	10.3 SE
Barrow	10.0 NE	9.9 NE	11.2 NE	11.9 NE	11.4 NE	11.0 NE	12.5 SW	12.9 NE	14.1 NE	15.0 NE	11.7 NE	10.4 NE	11.8 NE
Bethel	11.4 NE	11.5 NE	11.5 N	9.7 NW	9.2 NW	8.6 S	9.6 SW	10.4 S	10.3 NW	10.2 NE	12.8 NE	10.3 N	10.5 NE
Balun	5 SW	6 SW	7 SW	10 N	11 N	10 NW	10 NE	9 NE	10 SW	10 SW	6 SW	6 SW	8.4 SW
Cape Schmidt	13 SE	11 SE	12 SE	11 SE	11 SE	11 SE	10 NW	13 SE	14 NW	17 NW	14 NW	12 SE	12 SE
Dickson Island	19 S	20 S	17 S	16 S	15 NE	15 NE	14 NE	15 NE	16 S	18 S	17 S	18 S	17 S
Dutch Harbor	5.4 SE	8.5 SE	13.0 SE	8.9 SE	10.1 SE	10.3 SE	11.2 SE	10.1 SE	11.6 SE	10.5 NW	8.5 NW	8.1 SE	9.7 SE
Fairbanks	3.4 N	3.6 N	4.6 N	5.8 N	6.5 NE	6.1 SW	5.9 SW	5.5 S	5.2 NE	4.8 NE	3.9 N	3.5 N	4.9 N
Inari	10.2 SW	11.0 SW	10.7 SW	9.9 W	11.1 NE	12.8 NE	11.2 NE	9.9 NE	11.2 W	10.6 W	8.7 SW	9.2 SW	10.5 SW
Jan Mayen Is.	20.8 NNW	20.7 NW	18.1 NW	16.7 NW	12.5 E	13.8 E	11.9 E	14.0 E	16.0 E	18.4 NW	19.2 ENE	17.9 ENE	16.7 E

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Table 25 (cont.)

Average Surface Wind Velocity and Direction

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year
Kola	9.8 SW	9.1 SW	8.7 SW	7.6 SW	9.2 SW	10.1 N	9.0 N	7.4 N	8.1 SW	8.5 SW	9.8 SW	9.4 SW	8.9 SW
Lyakhovski Is.	10 NE	9 NE	10 NE	10 NE	12 E	12 E	11 NE	11 E	13 E	12 NW	9 NE	9 NE	10.6 NE
Malye Karmakuly	26 E	25 SE	23 SE	20 E	18 E	17 NW	16 N	13 N	17 N	18 S	22 E	23 E	20
Nanortalik	12.6 NW	12.1 N	11.6 N	10.6 N	7.7 W	10.1 W	7.7 W	6.8 N	9.1 N	9.6 N	11.1 N	11.1 N	10.0 N
Nome	9.8 NE	9.7 NE	9.3 NE	9.5 E	7.7 NE	7.5 W	8.6 W	9.1 SW	9.9 N	9.9 NE	8.8 NE	9.9 NE	9.1 NE
Obdorsk	8.5 S	10.4 S	11.1 S	12.6 W	13.0 NE	15.0 NE	11.9 NE	11.5 NE	12.1 W	10.6 S	11.6 S	8.2 S	11.4
Okhotsk	9.8 N	9.2 N	8.1 N	8.7 N	8.9 SE	9.2 SE	8.9 SE	8.3 SE	8.7 N	11.0 N	11.9 N	10.7 N	9.4
Olekminsk	1.6 W	2.5 W	2.9 W	3.8 W	4.5 W	4.5 W	4.3 W	4.3 W	4.0 W	4.7 W	2.9 W	2.5 W	3.5 W
Reykjavik	14.2 E	14.2 E	13.2 E	11.6 E	10.6 E	10.6 N	9.1 N	9.1 N	10.1 N	11.6 E	11.6 E	12.6 E	11.5 E
Sagastyr Is.	12.5 SE	8.9 SE	8.5 SE	11.4 E	13.6 E	14.5 E	16.6 E	13.9 E	15.2 SW	15.2 E	13.2 SW	10.3 S	12.8

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Table 25 (cont.)

Average Surface Wind Velocity and Direction

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year
St. Paul Is.	19.4 NW	19.4 NW	17.4 NW	16.1 N	13.9 NW	20.0 NW	10.9 S	12.1 SW	15.8 NW	17.2 N	16.6 N	16.2 NW	15.9 NW
Tiksi Bay	17.0 SW	12.5 SW	6.7 SW	6.0 SW	9.6 NE	9.2 NE	8.9 NE	10.5 E	11.6 W	11.2 SW	10.1 SW	8.1 SW	10.1 SW
Tromso	12.7 SW	12.7 SW	11.9 SW	9.7 SW	8.2 SW	9.7 SW	8.2 NE	7.5 SW	8.2 SW	9.7 SW	11.2 SW	11.2 SW	10.1 SW
Trondheim	14.2 SE	13.4 SE	14.2 SE	14.2 S	12.7 NW	12.7 NW	12.7 NW	12.7 NW	11.9 SE	13.4 SE	14.2 S	13.4 SE	13.3 SE
Turukhansk	12	12	11	10	11	8	7	8	9	11	11	11	10
Uelen	9.6 N	9.2 N	8.5 N	10.1 N	8.9 N	7.8 N	12.1 S	11.6 S	10.5 S	11.0 N	11.4 N	11.4 N	10.2 N
Vaigach	18.1	17.2	16.6	16.6	15.4	14.8	14.5	13.4	15.4	18.6	20.4	18.6	16.6
Vardo	21.6 SW	20.9 SW	20.9 SW	18.6 SW	15.7 NW	15.7 NW	13.4 NW	14.2 NW	17.1 NW	19.4 SW	20.9 SW	20.9 SW	18.3 SW
Verkhoyansk	1.1 SW	1.1 SW	1.6 SW	4.3 NE	6.0 NE	6.0 NE	5.4 NE	4.3 NE	3.1 SW	2.5 SW	1.3 SW	1.6 SW	3.2 SW
Wrangel Is.	15.0 NE	13.2 N	9.2 N	10.3 NE	9.2 NE	7.6 NE	9.6 E	10.1 NE	13.4 N	13.9 N	15.0 N	13.6 N	11.7
Yakutsk	2.5 N	2.5 N	2.5 N	4.7 NW	5.6 N	4.9 S	4.7 NW	4.5 NW	4.5 W	4.3 W	3.4 NW	2.5 N	3.9 N
Yugorski Strait	20 S	20 S	18 S	18 S	16 NE	14 NE	13 NE	13 NE	16 S	19 S	20 S	20 S	17 S

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Table 26

Percentage Frequency and Average Velocity (m.p.h.)
of Upper Air Winds for Adlavik, Iceland

Level	Surface		1600 ft.		3300 ft.		6600 ft.		9800 ft.		13,100 ft.	
Direction	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.
					Summer - (June and July)							
N	1	5	-	-	1	7	9	12	7	17	7	12
NNE	-	-	-	-	3	8	4	16	4	8	1	12
NE	4	7	4	7	4	14	2	8	4	9	1	9
ENE	8	12	15	10	7	14	4	12	3	13	3	13
E	16	8	7	10	12	15	9	20	11	21	10	29
ESE	10	12	8	8	7	9	6	16	5	30	7	24
SE	3	13	12	10	6	12	8	17	7	23	9	25
SSE	8	25	9	16	10	15	13	16	7	20	6	26
S	-	-	8	14	10	17	2	33	3	25	4	28
SSW	6	10	6	12	12	12	8	20	8	23	3	33
SW	11	15	12	15	9	16	6	25	10	18	4	24
WSW	7	24	11	17	9	22	2	30	5	16	3	10
W	6	9	1	9	6	16	9	18	4	21	3	15
WNW	1	5	5	5	-	-	8	20	10	18	11	18
NW	7	13	2	4	-	-	5	17	1	5	9	23
NNW	6	5	-	-	3	8	5	12	10	16	9	23
Calm	6	-	-	-	1	-	-	-	1	-	-	-
Av. Vel. No. Obs.	71		80		81		79		76		70	

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Table 27

Percentage Frequency and Average Velocity (m.p.h.)
of Upper Air Winds for Akureyri, Iceland

Level	Surface		1600 ft.		3300 ft.		6600 ft.		9800 ft.		13,100 ft.	
Direction	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.
Winter - (December - February)												
N	-	-	-	-	-	-	-	-	-	-	-	-
NNE	11	12	-	-	-	-	6	3	-	-	-	-
NE	-	-	-	-	-	-	-	-	-	-	-	-
ENE	-	-	-	-	-	-	-	-	9	7	-	-
E	-	-	-	-	11	3	-	-	-	-	12	18
ESE	-	-	-	-	-	-	6	9	-	-	-	-
SE	-	-	5	7	-	-	6	22	18	16	-	-
SSE	67	12	33	7	28	12	9	10	18	10	13	22
S	11	15	33	17	17	10	-	-	-	-	12	5
SSW	-	-	6	9	11	16	13	26	28	23	13	36
SW	6	9	11	17	5	24	19	12	-	-	-	-
WSW	5	21	6	16	17	16	6	7	9	12	12	24
W	-	-	-	-	6	5	6	26	-	-	25	15
WNW	-	-	-	-	-	-	13	26	9	47	-	-
NW	-	-	-	-	-	-	6	18	-	-	13	12
NNW	-	-	6	9	5	5	-	-	9	12	-	-
Calm	-	-	-	-	-	-	-	-	-	-	-	-
No. Obs.	18		18		18		16		11		8	
Spring - (March - May)												
N	12	12	11	13	2	8	10	17	5	28	9	30
NNE	2	3	1	12	2	8	6	16	5	24	3	60
NE	2	6	2	4	1	5	-	-	3	6	3	16
ENE	1	9	1	9	-	-	1	5	3	4	-	-
E	1	3	-	-	3	5	5	15	7	12	3	30
ESE	7	8	6	14	5	17	9	18	4	31	6	33
SE	9	9	12	12	11	16	7	22	7	22	8	15
SSE	34	8	25	8	17	8	11	15	9	17	9	18
S	13	12	17	12	20	12	10	16	12	21	12	25
SSW	1	3	7	9	10	8	8	12	7	23	11	16
SW	3	16	4	4	8	9	10	17	7	13	5	18
WSW	1	5	2	18	3	5	9	21	7	18	4	26
W	2	4	-	-	2	6	1	12	3	15	6	22
WNW	-	-	1	5	1	14	3	21	9	18	5	22
NW	2	6	-	-	2	8	5	12	5	18	11	24
NNW	9	7	11	8	13	14	5	13	7	21	5	41
Calm	1	-	-	-	-	-	-	-	-	-	-	-
No. Obs.	101		95		97		88		74		65	

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Table 27 (cont.)

Percentage Frequency and Average Velocity (m.p.h.)
of Upper Air Winds for Akureyri, Iceland

Level	Surface		1600 ft.		3300 ft.		6600 ft.		9800 ft.		13,100 ft.	
Direction	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.
Summer - (June - August)												
N	10	7	12	9	15	9	5	17	10	13	8	20
NNE	3	3	4	5	6	6	4	20	6	21	5	29
NE	-	-	-	-	5	6	5	17	5	16	7	17
ENE	1	2	3	2	1	4	8	16	4	22	3	8
E	1	5	1	5	2	7	4	7	-	-	-	-
ESE	4	2	4	2	7	7	4	16	3	10	-	-
SE	10	7	7	6	5	5	8	8	3	14	6	21
SSE	11	7	10	9	7	7	1	14	5	21	8	17
S	15	13	19	9	14	10	8	13	10	18	10	25
SSW	5	15	10	7	11	7	7	20	5	29	5	18
SW	7	14	3	13	9	9	6	14	7	17	6	22
WSW	-	-	1	7	1	7	13	21	8	29	5	24
W	1	2	1	5	5	6	7	14	6	12	7	23
WNW	-	-	-	-	1	16	6	13	10	15	6	30
NW	4	16	4	5	2	10	6	15	10	22	11	25
NNW	25	10	18	9	7	7	3	18	8	21	13	20
Calm	3	-	3	-	2	-	-	-	-	-	-	-
No. Obs.	73		73		86		79		72		62	
Autumn - (September - November)												
N	6	5	7	5	2	5	5	21	6	18	2	26
NNE	-	-	1	2	3	6	4	24	2	14	4	12
NE	-	-	-	-	1	9	1	16	2	18	-	-
ENE	1	5	2	5	-	-	1	9	-	-	2	9
E	-	-	-	-	1	16	5	16	5	7	4	15
ESE	1	7	-	-	1	9	1	9	5	16	6	12
SE	4	7	1	2	2	7	1	22	3	18	2	26
SSE	47	10	19	9	7	8	11	12	10	20	4	32
S	18	13	40	12	29	12	7	21	6	18	12	32
SSW	8	7	11	9	23	8	10	23	11	24	10	25
SW	2	3	4	6	9	10	16	14	8	20	14	28
WSW	1	14	4	8	14	6	11	14	14	16	8	24
W	1	2	1	16	1	2	10	16	8	20	6	29
WNW	1	5	-	-	4	5	11	16	9	21	2	12
NW	1	5	-	-	-	-	4	20	5	29	16	26
NNW	5	6	4	7	2	6	4	12	6	30	8	30
Calm	4	-	6	-	1	-	-	-	-	-	-	-
No. Obs.	85		73		89		81		63		50	

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Table 28

Percentage Frequency and Average Velocity (m.p.h.)
of Upper Air Winds for Angmagssalik, Greenland

Level	Surface		1600 ft.		3300 ft.		6600 ft.		9800 ft.		13,100 ft.	
Direction	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.
					Summer - (June - August)							
N	3	5	6	5	4	6	2	13	5	8	4	16
NNE	2	6	3	5	3	7	6	10	4	9	7	12
NE	2	7	4	6	9	8	11	12	12	16	10	9
ENE	2	6	6	7	20	13	24	18	12	12	13	12
E	3	6	4	5	8	8	5	14	6	12	7	14
ESE	3	7	7	7	5	6	4	7	4	8	3	14
SE	3	5	8	5	2	5	2	7	4	12	2	23
SSE	4	5	4	5	4	4	4	9	1	7	4	18
S	2	6	3	5	1	4	2	9	9	12	7	14
SSW	-	-	2	6	2	9	4	8	3	9	5	15
SW	-	-	2	5	3	5	5	17	6	14	3	10
WSW	1	6	5	5	5	6	7	12	6	12	3	18
W	3	3	4	5	9	8	9	9	6	12	8	10
WNW	2	3	5	5	8	5	2	5	9	12	10	14
NW	2	2	4	6	3	6	5	9	7	14	10	17
NNW	2	5	4	7	5	9	4	5	2	13	3	13
Calm	66	-	29	-	9	-	4	-	4	-	1	-
No. Obs.	244		244		243		192		159		134	

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Table 29

Percentage Frequency and Average Velocity (m.p.h.)
of Upper Air Winds for Barrow, Alaska

Level	Surface		1600 ft.		3300 ft.		6600 ft.		9800 ft.		13,100 ft.	
Direction	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.
Winter - (December - February)												
N	2	8	4	15	3	16	4	18	6	18	4	28
NNE	6	8	5	14	6	15	5	22	7	22	6	22
NE	9	12	6	17	7	20	11	23	13	26	10	25
ENE	28	14	18	23	15	25	14	30	9	32	12	23
E	11	15	19	31	20	30	13	28	11	29	8	30
ESE	5	12	9	32	6	29	5	24	2	18	2	15
SE	5	10	4	22	3	16	3	15	1	10	2	7
SSE	2	7	2	16	2	16	1	12	2	17	2	10
S	2	14	2	14	3	15	3	20	4	19	2	14
SSW	2	16	2	30	4	23	7	28	8	25	7	24
SW	5	12	5	24	6	24	7	23	7	25	8	33
WSW	3	10	5	23	6	24	5	25	7	23	11	21
W	4	10	5	20	4	16	5	17	6	18	7	24
WNW	7	9	5	16	4	17	5	18	7	18	6	21
NW	5	10	6	15	7	15	8	16	5	24	8	30
NNW	4	6	3	15	4	17	4	20	5	22	5	18
Calm	-	-	-	-	-	-	-	-	-	-	-	-
No. Obs.	396		385		324		269		204			
Spring - (March - May)												
N	3	9	3	12	3	12	4	17	5	22	6	16
NNE	4	12	3	15	2	15	5	17	6	16	5	21
NE	15	12	8	15	8	16	7	14	5	16	3	9
ENE	30	17	18	26	18	26	20	25	17	24	19	22
E	16	13	30	33	31	37	23	32	17	30	10	29
ESE	7	10	11	29	11	22	8	23	7	21	7	18
SE	4	9	4	12	5	9	2	13	1	10	2	16
SSE	2	6	3	15	3	9	2	7	2	7	4	15
S	2	7	1	13	1	14	2	22	3	17	4	12
SSW	2	10	1	18	3	7	1	18	2	21	4	18
SW	1	12	2	16	3	15	7	18	7	18	4	26
WSW	3	12	3	15	2	21	4	18	3	25	6	23
W	3	12	6	17	4	18	5	14	5	17	8	13
WNW	3	14	3	16	1	18	2	10	7	13	5	21
NW	3	6	3	16	2	21	4	17	3	18	6	15
NNW	2	12	1	24	3	18	4	17	4	17	6	22
Calm	-	-	-	-	-	-	-	-	1	-	1	-
No. Obs.	296		284		233		202		166		134	

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Table 29 (cont.)

Percentage Frequency and Average Velocity (n.p.h.)
of Upper Air Winds for Barrow, Alaska

Level	Surface		1600 ft.		3300 ft.		6600 ft.		9800 ft.		13,100 ft.	
Direction	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.
Summer - (June - August)												
N	4	6	5	8	3	9	1	10	3	13	4	10
NNE	7	8	4	9	3	7	3	9	-	-	-	-
NE	3	9	3	9	4	9	4	12	5	15	1	26
ENE	9	12	4	14	6	10	2	9	2	13	2	12
E	15	13	8	20	5	20	6	16	2	16	2	9
ESE	8	13	6	18	4	18	5	9	4	12	6	10
SE	5	12	9	16	3	16	2	18	2	16	2	10
SSE	2	10	5	18	6	18	3	13	3	14	5	17
S	1	14	3	10	10	13	8	14	7	13	9	16
SSW	2	10	4	13	4	12	7	14	10	15	11	18
SW	10	14	8	20	10	20	12	21	16	24	13	23
WSW	13	13	14	25	15	24	15	23	13	22	5	22
W	6	12	12	25	14	28	17	24	16	20	13	21
WNW	7	10	6	22	5	16	6	16	7	17	10	16
NW	3	7	5	16	6	16	7	15	7	9	8	12
NNW	5	7	3	10	2	13	1	13	3	16	8	16
Calm	-	-	1	-	-	-	1	-	-	-	1	-
No. Obs.	262		257		210		161		124		92	
Autumn - (September - November)												
N	3	10	5	14	3	10	1	14	5	14	7	28
NNE	1	15	4	13	3	18	3	16	7	17	7	22
NE	7	15	5	17	4	15	7	16	5	16	5	23
ENE	16	18	15	25	11	25	9	23	5	21	5	32
E	17	17	14	33	13	31	12	22	6	26	5	26
ESE	14	15	14	31	15	29	11	24	8	21	5	16
SE	11	12	7	26	9	18	10	17	11	18	5	24
SSE	5	10	6	20	7	16	7	14	4	18	8	14
S	4	13	4	21	5	24	6	14	3	22	5	16
SSW	6	12	4	17	5	16	8	22	7	22	7	29
SW	4	12	4	22	6	17	4	15	6	19	2	17
WSW	3	12	6	21	6	18	5	17	8	13	6	17
W	3	15	6	18	6	20	5	12	7	13	12	17
WNW	2	14	2	23	2	15	4	21	7	25	5	21
NW	2	12	2	15	4	15	5	22	6	18	10	25
NNW	2	8	2	9	1	12	3	16	4	14	6	15
Calm	-	-	-	-	-	-	-	-	1	-	-	-
No. Obs.	399		381		281		208		159		109	

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Table 30

Percentage Frequency and Average Velocity (m.p.h.) of Upper Air Winds for Camp Scott, Greenland

Level	Surface		1600 ft.		3300 ft.		6600 ft.		9800 ft.		13,100 ft.	
Direction	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.
					Winter - (December - February)							
N	9	**	5	7	10	14	3	14	-	-	-	-
NNE	24		4	10	6	8	3	18	4	36	-	-
NE	33		11	5	6	7	3	14	4	2	-	-
ENE	3		2	2	2	5	-	-	-	-	-	-
E	7		5	5	2	5	-	-	-	-	-	-
ESE	-		7	12	4	7	11	8	8	9	-	-
SE	3		4	12	8	9	11	8	4	18	7	43
SSE	2		9	6	10	12	16	17	15	23	20	16
S	-		14	7	12	6	11	21	4	9	13	21
SSW	2		4	7	6	12	3	5	15	22	13	28
SW	-		2	2	8	8	6	8	15	9	20	12
WSW	2		-	-	2	5	6	5	4	14	-	-
W	4		7	8	4	2	-	-	4	2	-	-
WNW	4		5	9	-	-	8	22	-	-	-	-
NW	2		16	8	10	8	8	13	15	14	13	21
NNW	5		5	5	10	12	11	17	8	15	14	16
Calm	-	-	-	-	-	-	-	-	-	-	-	-
No. Obs.	57		56		50		36		26		15	
					Spring (March - April)							
N	3	**	9	5	12	10	4	16	4	15	3	5
NNE	21		8	3	10	8	4	14	-	-	3	14
NE	33		5	5	2	8	3	14	4	17	-	-
ENE	9		4	5	4	6	-	-	2	24	-	-
E	8		1	5	2	2	3	14	-	-	-	-
ESE	3		2	5	5	5	4	9	4	13	3	6
SE	1		2	9	4	8	8	14	12	14	14	8
SSE	3		9	5	9	9	19	15	25	17	14	17
S	1		10	6	9	10	21	21	21	23	17	23
SSW	2		8	5	11	8	10	16	14	18	14	18
SW	1		7	5	7	7	8	13	-	-	6	12
WSW	1		2	3	1	16	6	5	4	13	6	6
W	1		4	5	2	5	-	-	2	45	-	-
WNW	3		3	6	2	9	2	5	2	9	8	28
NW	5		14	7	7	7	4	10	6	21	3	26
NNW	8		12	7	13	9	4	9	-	-	9	29
Calm	-	-	-	-	-	-	-	-	-	-	-	-
No. Obs.	92		92		85		68		49		35	

**No velocity data available.

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Table 30 (cont.)

Percentage Frequency and Average Velocity (m.p.h.)
of Upper Air Winds for Camp Scott, Greenland

Level	Surface		1600 ft.		3300 ft.		6600 ft.		9800 ft.		13,100 ft.	
Direction	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.
					Autumn - (September - November)							
N	3	**	3	3	3	6	12	14	9	18	4	16
NNE	8		6	5	6	6	4	9	2	9	6	16
NE	42		1	2	4	5	3	15	5	14	2	21
ENE	19		3	3	4	6	3	8	-	-	-	-
E	13		3	5	1	5	3	6	-	-	-	-
ESE	1		10	7	6	7	3	8	2	14	2	21
SE	-		14	5	11	10	1	5	14	13	8	15
SSE	-		22	7	7	9	11	12	7	14	8	18
S	1		6	8	5	8	12	13	10	13	4	13
SSW	2		5	5	11	7	7	8	10	13	11	14
SW	1		1	5	5	3	7	8	5	18	11	20
WSW	2		5	5	2	6	4	7	8	9	13	22
W	1		1	12	1	7	-	-	8	8	6	7
WNW	-		3	7	4	5	5	7	8	14	8	8
NW	2		3	8	5	10	10	10	5	16	13	16
NNW	4		13	6	25	9	11	13	7	12	2	18
Calm	1	-	1	-	-	-	4	-	-	-	2	-
No. Obs.	91		88		83		73		59		48	

**No velocity data available.

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Table 31

Percentage Frequency and Average Velocity (m.p.h.) of Upper Air Winds for Cape Cheliuskin, Siberia

Level	Surface		1600 ft.		3300 ft.		6600 ft.		9800 ft.		13,100 ft.	
Direction	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.
Winter - (December - February)												
N	-		-		8		11		25		-	
NNE	2		4		-		4		-		-	
NE	7		4		-		-		25		-	
ENE	5		6		3		4		-		33	
E	7		14		5		12		-		-	
ESE	2		6		16		15		25		-	
SE	7		6		5		8		-		-	
SSE	2		2		3		-		-		33	
S	17		8		11		15		-		-	
SSW	2		14		8		-		25		-	
SW	13		8		5		8		-		-	
WSW	4		2		3		-		-		-	
W	2		6		-		-		-		-	
WNW	-		4		10		-		-		-	
NW	-		10		10		8		-		-	
NNW	-		-		5		15		-		34	
Calm	30	-	6	-	8	-	-	-	-	-	-	-
Av. Vel.		7		12		14		17		19		11
No. Obs.		54		52		38		26		4		3
Spring - (March - May)												
N	-		5		7		13		4		-	
NNE	1		3		4		-		2		5	
NE	3		3		2		7		4		5	
ENE	5		11		7		1		2		-	
E	16		10		16		9		4		7	
ESE	5		10		8		10		17		12	
SE	5		13		8		12		11		7	
SSE	-		5		11		12		17		19	
S	5		7		13		15		9		7	
SSW	5		2		8		1		2		5	
SW	2		5		2		6		6		2	
WSW	5		5		3		3		4		10	
W	6		7		2		2		4		2	
WNW	2		2		4		1		4		10	
NW	2		2		2		6		2		2	
NNW	-		2		2		-		4		5	
Calm	38	-	8	-	1	-	2	-	4	-	2	-
Av. Vel.		8		14		16		19		21		25
No. Obs.		102		97		88		68		52		42

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Table 31 (cont.)

Percentage Frequency and Average Velocity (m.p.h.)
of Upper Air Winds for Cape Cheliuskin, Siberia

Level	Surface		1600 ft.		3300 ft.		6600 ft.		9800 ft.		13,100 ft.	
Direction	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.
Summer - (June - August)												
N	-		7		9		8		10		8	
NNE	5		4		4		5		4		-	
NE	4		4		4		5		3		8	
ENE	2		6		2		-		-		4	
E	17		6		7		8		7		8	
ESE	7		8		4		2		-		-	
SE	9		6		6		3		-		4	
SSE	4		6		6		3		10		4	
S	2		5		6		18		17		12	
SSW	2		8		7		3		3		12	
SW	9		6		9		8		17		4	
WSW	2		8		4		5		-		-	
W	13		12		9		13		3		12	
WNW	9		6		4		3		3		8	
NW	2		4		4		3		3		4	
NNW	13		4		11		13		17		8	
Calm	-	-	-	-	4	-	-	-	3	-	4	-
Av. Vel.		10		17		16		17		18		21
No. Obs.		101		51		47		38		30		25
Autumn - (September - November)												
N	11		14		-		-		-		-	
NNE	11		14		22		-		50		-	
NE	-		-		11		-		-		-	
ENE	-		-		-		-		-		-	
E	-		-		11		-		-		-	
ESE	-		-		-		-		-		-	
SE	-		-		-		-		-		-	
SSE	-		29		23		25		25		-	
S	-		-		-		-		-		-	
SSW	11		-		-		-		-		-	
SW	34		14		11		-		-		33	
WSW	-		29		22		50		25		34	
W	-		-		-		23		-		33	
WNW	-		-		-		-		-		-	
NW	-		-		-		-		-		-	
NNW	11		-		-		-		-		-	
Calm	22	-	-	-	-	-	-	-	-	-	-	-
Av. Vel.		9		18		21		25		22		17
No. Obs.		9		7		9		4		4		3

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Table 32

Percentage Frequency and Average Velocity (m.p.h.)
of Upper Air Winds for Dickson Island, Siberia

Level	Surface		1600 ft.		3300 ft.		6600 ft.		9800 ft.		13,100 ft.	
Direction	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.
					Winter - (December - February)							
N	2		8		10		10		6		50	
NNE	9		12		8		5		16		12	
NE	11		11		13		15		16		-	
ENE	6		9		9		5		11		-	
E	5		4		8		10		-		-	
ESE	2		5		5		2		-		13	
SE	2		5		6		5		5		-	
SSE	11		2		1		5		5		-	
S	16		8		4		7		5		-	
SSW	3		7		2		2		5		-	
SW	4		4		7		2		-		-	
WSW	3		4		6		5		-		-	
W	2		7		5		5		5		12	
WNW	1		3		4		5		5		13	
NW	1		5		7		10		5		-	
NNW	3		4		4		7		16		-	
Calm	19	-	2	-	1	-	-	-	-	-	-	-
Av. Vel.		10		17		17		17		14		18
No. Obs.		129		111		91		41		19		8
					Spring - (March - May)							
N	6		8		12		8		9		3	
NNE	7		5		1		5		1		5	
NE	10		9		10		8		12		10	
ENE	15		7		9		13		11		7	
E	8		12		12		9		9		12	
ESE	5		9		7		8		4		5	
SE	4		7		9		7		3		4	
SSE	10		8		8		4		4		2	
S	5		11		7		6		4		4	
SSW	6		4		5		2		3		2	
SW	-		3		2		4		4		2	
WSW	1		3		1		4		4		3	
W	1		3		5		3		7		12	
WNW	3		3		3		4		8		5	
NW	1		4		4		11		8		16	
NNW	2		4		3		4		5		5	
Calm	16	-	-	-	2	-	-	-	4	-	3	-
Av. Vel.		11		17		17		18		18		23
No. Obs.		185		149		127		91		75		58

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Table 32 (cont.)

Percentage Frequency and Average Velocity (m.p.h.)
of Upper Air Winds for Dickson Island, Siberia

Level	Surface		1600 ft.		3300 ft.		6600 ft.		9800 ft.		13,100 ft.	
Direction	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.
Summer - (June - August)												
N	3		8		2		1		4		7	
NNE	16		6		6		8		7		5	
NE	7		3		8		3		6		5	
ENE	10		4		4		5		2		-	
E	5		5		7		6		9		7	
ESE	7		9		6		6		11		12	
SE	3		5		8		11		2		5	
SSE	4		9		9		8		9		12	
S	5		10		9		11		9		9	
SSW	6		9		8		11		9		7	
SW	4		5		5		11		9		12	
WSW	8		4		5		3		9		2	
W	2		6		6		3		4		7	
WNW	5		5		6		3		4		5	
NW	2		4		6		3		4		-	
NNW	9		5		3		5		-		5	
Calm	4	-	3	-	2	-	2	-	2	-	-	-
Av. Vel.		12		16		18		20		22		22
No. Obs.		152		108		87		64		46		42
Autumn - (September - November)												
N	5		4		1		-		9		15	
NNE	6		3		6		9		5		7	
NE	13		13		6		12		5		-	
ENE	22		9		5		9		9		-	
E	8		24		32		9		4		22	
ESE	5		7		6		19		18		7	
SE	-		5		1		6		18		14	
SSE	5		6		6		3		5		7	
S	4		4		5		3		5		-	
SSW	1		1		5		-		-		7	
SW	1		7		2		3		-		-	
WSW	1		1		5		-		-		-	
W	2		5		5		12		4		7	
WNW	3		2		-		-		4		-	
NW	5		2		5		9		14		14	
NNW	2		6		8		3		-		-	
Calm	17	-	1	-	2	-	3	-	-	-	-	-
Av. Vel.		10		18		19		17		17		21
No. Obs.		104		83		63		33		22		14

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Table 33

Percentage Frequency and Average Velocity (m.p.h.)
of Upper Air Winds for East Station, Greenland

Level	Surface		1600 ft.		3300 ft.		6600 ft.		9800 ft.		13,100 ft.	
Direction	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.
Winter - (December - February)												
N	-	-	3	7	8	7	-	-	3	7	4	9
NNE	-	-	3	16	8	14	10	12	3	12	4	12
NE	2	2	8	7	3	7	13	18	-	-	4	5
ENE	31	5	-	-	5	9	3	5	11	16	-	-
E	8	7	5	9	3	12	-	-	7	14	13	10
ESE	-	-	-	-	-	-	-	-	3	7	-	-
SE	-	-	-	-	-	-	-	-	-	-	-	-
SSE	-	-	-	-	-	-	3	12	3	38	9	26
S	3	2	-	-	3	12	7	21	11	15	-	-
SSW	-	-	3	5	3	14	6	14	3	22	9	18
SW	-	-	-	-	11	10	10	16	11	10	13	28
WSW	-	-	3	5	6	8	10	14	21	20	13	16
W	3	5	8	16	6	12	6	28	-	-	4	16
WNW	-	-	46	17	22	17	16	13	7	22	9	21
NW	3	5	8	7	14	13	3	9	10	10	9	9
NNW	3	5	5	9	8	7	13	9	7	13	9	10
Calm	47	-	8	-	36	-	31	-	-	-	-	-
No. Obs.	38		37		36		31		29		23	
Spring - (March - May)												
N	-	-	-	-	-	-	3	18	13	15	10	21
NNE	7	6	-	-	7	8	11	15	-	-	5	16
NE	-	-	7	3	15	13	-	-	5	18	5	26
ENE	21	6	3	2	-	-	11	10	4	7	-	-
E	7	5	-	-	-	-	4	2	4	26	-	-
ESE	-	-	3	2	-	-	4	7	-	-	5	22
SE	-	-	-	-	-	-	4	7	4	14	-	-
SSE	-	-	-	-	3	2	4	12	9	16	10	30
S	3	2	3	7	4	5	-	-	9	18	5	9
SSW	3	2	3	5	4	2	15	21	4	45	15	35
SW	-	-	3	16	4	16	18	14	18	18	15	24
WSW	-	-	-	-	7	15	11	8	18	21	15	21
W	3	2	10	9	4	5	4	18	4	14	10	21
WNW	-	-	34	17	33	20	-	-	4	7	-	-
NW	7	3	17	6	15	12	11	12	4	9	-	-
NNW	-	-	10	8	-	-	-	-	-	-	5	12
Calm	49	-	7	-	4	-	-	-	-	-	-	-
No. Obs.	29		30		27		27		23		20	

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Table 33 (cont.)

Percentage Frequency and Average Velocity (m.p.h.)
of Upper Air Winds for East Station, Greenland

Level	Surface		1600 ft.		3300 ft.		6600 ft.		9800 ft.		13,100 ft.	
Direction	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.
Summer - (June - August)												
N	-	-	7	7	46	12	27	16	23	21	13	22
NNE	-	-	7	6	12	11	18	13	-	-	13	25
NE	-	-	4	7	-	-	-	-	-	-	-	-
ENE	-	-	-	-	-	-	-	-	5	14	7	16
E	-	-	4	7	-	-	9	7	6	12	-	-
ESE	-	-	-	-	-	-	-	-	6	12	13	9
SE	-	-	8	6	4	2	-	-	6	2	7	9
SSE	-	-	4	2	-	-	-	-	-	-	-	-
S	8	2	-	-	4	2	-	-	-	-	-	-
SSW	-	-	4	2	-	-	-	-	-	-	-	-
SW	-	-	-	-	-	-	9	15	-	-	7	18
WSW	-	-	4	2	-	-	14	8	11	13	7	14
W	4	5	8	8	17	10	-	-	16	9	20	17
WNW	-	-	11	7	-	-	9	3	6	14	-	-
NW	-	-	4	5	-	-	5	18	16	14	13	14
NNW	-	-	8	2	17	9	9	25	-	-	-	-
Calm	88	-	27	-	-	-	-	-	-	-	-	-
No. Obs.	23		26		24		22		18		15	
Autumn - (September - November)												
N	-	-	-	-	5	7	25	10	15	25	-	-
NNE	-	-	4	21	-	-	6	22	-	-	9	5
NE	9	5	-	-	-	-	-	-	-	-	17	18
ENE	9	7	4	5	5	7	-	-	7	9	8	7
E	39	6	9	7	-	-	-	-	-	-	-	-
ESE	-	-	-	-	-	-	-	-	-	-	-	-
SE	-	-	9	6	-	-	-	-	-	-	-	-
SSE	4	5	-	-	-	-	6	7	-	-	-	-
S	-	-	-	-	-	-	6	9	7	14	8	18
SSW	4	9	-	-	-	-	13	18	14	12	8	9
SW	-	-	-	-	5	21	6	16	-	-	8	7
WSW	-	-	4	2	-	-	-	-	7	9	-	-
W	-	-	9	23	16	15	13	8	14	17	-	-
WNW	-	-	31	22	37	16	6	12	7	16	17	21
NW	9	12	17	16	16	12	19	8	22	16	8	26
NNW	-	-	13	10	16	9	-	-	7	9	17	30
Calm	26	-	-	-	-	-	-	-	-	-	-	-
No. Obs.	23		23		19		16		14		12	

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Table 34

Percentage Frequency and Average Velocity (m.p.h.)
of Upper Air Winds for Eismitte, Greenland

Level	Surface		13,100 ft.		16,400 ft.		19,700 ft.		23,000 ft.		26,200 ft.	
Direction	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.
					May 28 - October 4							
N	5	9	6	10	-	-	3	21	6	28	3	33
NNE	-	-	9	9	6	21	8	21	13	21	17	30
NE	5	13	14	14	9	10	20	17	12	25	17	44
ENE	11	15	12	12	14	18	6	30	6	58	3	50
E	24	16	6	30	3	22	-	-	6	28	3	5
ESE	5	22	3	13	11	14	9	29	9	26	7	28
SE	14	15	9	18	6	26	9	18	3	18	7	31
SSE	16	13	17	20	9	24	6	29	12	24	7	29
S	3	9	6	6	3	21	9	23	3	36	3	33
SSW	-	-	-	-	6	21	-	-	3	33	-	-
SW	3	14	-	-	-	-	3	7	3	12	-	-
WSW	5	25	9	25	9	29	6	55	3	21	3	24
W	-	-	-	-	3	26	3	40	3	45	7	33
WNW	3	18	9	20	6	25	3	64	3	81	7	38
NW	-	-	-	-	6	18	9	22	9	29	10	41
NNW	3	9	-	-	9	17	6	22	6	28	3	40
Calm	3	-	-	-	-	-	-	-	-	-	3	-
No. Obs.	37		34		34		34		33		30	

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Table 35

Percentage Frequency and Average Velocity (m.p.h.)
of Upper Air Winds for Etah, Greenland

Level	Surface		1600 ft.		3300 ft.		6600 ft.		9800 ft.		13,100 ft.	
Direction	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.
Winter - (December - February)												
N	1	2	1	7	3	17	7	15	6	9	11	22
NNE	5	10	3	15	19	30	4	41	-	-	-	-
NE	40	8	32	24	21	18	7	8	6	7	5	21
ENE	26	12	22	6	10	12	4	7	3	12	-	-
E	12	12	6	6	5	6	13	14	3	18	5	16
ESE	1	2	1	2	3	5	8	13	6	22	5	33
SE	4	3	1	5	1	12	6	12	20	23	32	25
SSE	1	2	6	5	7	8	6	25	8	12	5	7
S	1	9	11	13	15	12	13	16	17	17	21	16
SSW	3	2	11	12	12	13	4	7	3	5	-	-
SW	-	-	4	8	3	13	4	15	5	16	-	-
WSW	1	12	-	-	-	-	9	7	-	-	-	-
W	1	2	-	-	-	-	-	-	3	16	-	-
WNW	1	2	1	2	-	-	2	7	-	-	-	-
NW	-	-	1	2	3	6	4	23	20	18	11	18
NNW	1	2	-	-	3	16	7	13	-	-	5	21
Calm	2	-	-	-	-	-	2	-	-	-	-	-
No. Obs.	85		85		74		53		35		19	
Spring - (March - May)												
N	-	-	3	17	3	37	8	28	6	22	8	26
NNE	5	7	7	20	21	29	11	22	6	28	1	26
NE	21	8	32	30	25	25	15	23	6	18	6	17
ENE	27	10	17	15	3	12	14	10	12	21	13	21
E	14	10	3	8	5	8	7	12	10	14	6	16
ESE	6	6	3	3	1	18	3	8	8	15	12	21
SE	-	-	2	2	1	7	4	12	6	15	9	12
SSE	-	-	2	3	5	9	4	8	9	12	6	12
S	2	3	5	9	12	15	10	15	12	16	8	17
SSW	1	7	17	9	9	12	4	9	3	5	3	5
SW	3	2	5	5	8	12	3	5	1	9	-	-
WSW	3	2	2	5	1	3	1	5	1	22	4	14
W	-	-	-	-	1	5	1	12	1	2	4	9
WNW	1	2	-	-	-	-	4	7	3	25	4	26
NW	1	2	1	2	-	-	5	12	8	18	4	26
NNW	1	2	1	24	4	14	6	13	8	10	12	18
Calm	15	-	-	-	-	-	-	-	-	-	-	-
No. Obs.	145		115		136		100		73		68	

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Table 35 (cont.)

Percentage Frequency and Average Velocity (m.p.h.)
of Upper Air Winds for Etah, Greenland

Level	Surface		1600 ft.		3300 ft.		6600 ft.		9800 ft.		13,100 ft.	
Direction	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.
Summer - (June only)												
N	-	-	2	2	-	-	17	21	11	15	7	10
NNE	4	3	2	24	8	21	7	18	6	18	-	-
NE	9	9	26	21	30	21	5	37	3	14	-	-
ENE	8	8	23	16	11	14	5	8	3	24	3	2
E	19	7	4	10	6	9	7	13	-	-	-	-
ESE	8	6	-	-	2	5	8	7	11	15	18	15
SE	-	-	2	2	2	2	10	9	8	8	14	18
SSE	2	2	2	2	9	7	15	10	14	12	10	12
S	6	3	4	14	11	9	10	7	9	7	4	14
SSW	4	8	23	16	15	17	2	5	-	-	-	-
SW	13	5	4	7	4	9	-	-	3	9	4	16
WSW	10	5	-	-	-	-	5	5	9	7	4	5
W	2	5	2	2	2	2	-	-	3	16	7	16
WNW	2	7	2	5	-	-	5	6	3	21	7	14
NW	-	-	4	2	-	-	2	5	8	7	4	9
NNW	-	-	-	-	-	-	2	7	9	17	18	10
Calm	13	-	-	-	-	-	-	-	-	-	-	-
No. Obs.	52		52		47		41		35		28	
Autumn - (September - November)												
N	-	-	8	17	9	17	16	24	11	31	6	33
NNE	10	14	7	30	30	33	8	29	7	29	6	16
NE	35	8	55	29	26	29	11	41	4	12	6	9
ENE	15	12	8	8	4	7	21	15	11	16	-	-
E	23	15	2	7	2	7	-	-	4	14	13	17
ESE	6	10	-	-	2	7	-	-	4	7	-	-
SE	2	7	2	5	2	5	8	12	4	26	-	-
SSE	-	-	-	-	-	-	-	-	-	-	6	18
S	-	-	5	14	4	21	3	7	-	-	-	-
SSW	-	-	6	8	4	13	-	-	7	18	-	-
SW	2	16	2	7	7	14	11	12	4	14	19	12
WSW	2	5	-	-	3	5	-	-	4	5	-	-
W	-	-	-	-	-	-	3	9	4	7	6	14
WNW	2	5	-	-	2	2	3	12	7	14	6	24
NW	-	-	3	5	-	-	5	16	4	12	13	18
NNW	-	-	-	-	5	16	11	15	18	24	19	32
Calm	3	-	2	-	-	-	-	-	7	-	-	-
No. Obs.	60		60		54		37		27		16	

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Table 36

Percentage Frequency and Average Velocity (m.p.h)
of Upper Air Winds for Fairbanks, Alaska

Level	Surface		1600 ft.		3300 ft.		6600 ft.		9800 ft.		13,100 ft.		16,400 ft.	
Direction	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.
Winter - (December - February)														
N	12	4	1	4	1	6	1	13	2	16	2	24	2	20
NNE	4	5	1	4	1	5	3	12	2	18	3	24	2	16
NE	7	6	5	9	4	10	4	16	6	20	3	22	5	10
ENE	3	6	22	13	7	14	9	23	7	24	4	21	3	19
E	8	6	33	13	24	20	12	28	7	26	4	23	2	30
ESE	2	5	16	13	21	22	9	23	4	19	3	10	3	20
SE	3	3	6	12	13	18	4	16	3	16	3	15	1	17
SSE	1	5	3	8	6	15	6	17	2	18	3	22	1	31
S	4	4	2	6	4	14	9	19	10	19	8	23	8	18
SSW	1	4	1	8	3	15	13	20	14	22	13	20	11	22
SW	3	4	2	5	4	15	10	21	10	22	14	24	14	27
WSW	2	6	2	10	3	16	5	18	9	22	9	23	10	22
W	4	5	3	14	4	19	5	20	7	19	8	20	11	26
WNW	2	4	1	12	2	14	4	14	7	21	11	22	17	31
NW	7	4	1	6	2	11	4	19	5	18	8	22	5	24
NNW	5	4	-	10	1	10	2	13	5	16	4	22	5	29
Calm	32	-	1	-	-	-	-	-	-	-	-	-	-	-
Av. Vel.	3		12		17		20		21		22		24	
No. Obs.	1116		1118		1060		824		527		296		147	
Spring - (March - May)														
N	8	5	3	6	13	5	1	8	3	13	4	16	4	25
NNE	3	6	3	7	3	8	2	9	3	10	3	16	2	19
NE	9	6	7	8	3	8	3	12	4	15	3	17	3	14
ENE	5	7	16	12	6	11	7	15	4	18	4	17	3	18
E	15	6	21	12	15	14	10	18	6	19	4	17	3	22
ESE	2	5	12	10	17	14	10	16	6	18	5	17	5	20
SE	5	6	5	9	11	13	8	11	8	14	7	17	5	19
SSE	2	4	3	7	4	11	8	13	9	14	8	17	9	20
S	5	5	2	6	3	10	9	13	11	16	10	17	9	20
SSW	4	6	3	8	4	9	12	16	14	18	14	20	10	25
SW	9	6	4	8	7	12	10	16	11	19	11	20	13	24
WSW	4	9	7	9	8	12	8	17	7	19	7	20	9	22
W	5	6	6	11	7	12	5	14	5	14	7	19	10	22
WNW	1	5	2	6	4	9	4	13	4	21	4	22	4	26
NW	5	4	2	6	3	7	2	10	3	14	4	17	5	26
NNW	3	5	3	5	2	5	1	11	2	12	5	20	6	24
Calm	15	-	1	-	-	-	-	-	-	-	-	-	-	-
Av. Vel.	4.9		9.6		12.1		14.3		16.6		18.3		22.1	
No. Obs.	1343		1344		1327		1170		943		694		461	

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Table 36 (cont.)

Percentage Frequency and Average Velocity (m.p.h.)
of Upper Air Winds for Fairbanks, Alaska

Level	Surface		1600 ft.		3300 ft.		6600 ft.		9800 ft.		13,100 ft.		16,400 ft.	
Direction	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.
Summer - (June - August)														
N	3	4	2	7	2	7	3	10	4	12	4	12	4	15
NNE	1	5	2	8	3	7	3	11	2	12	3	16	3	15
NE	5	5	3	7	4	10	2	10	3	12	5	14	5	15
ENE	3	4	7	9	5	9	7	11	4	13	3	17	5	17
E	16	5	12	10	8	11	7	12	6	12	6	15	6	14
ESE	4	4	8	9	7	11	7	12	6	14	6	13	5	15
SE	7	5	6	7	7	10	5	12	8	14	8	16	8	14
SSE	2	5	4	5	3	10	4	10	8	14	10	14	9	17
S	5	5	2	7	3	11	8	13	9	14	10	13	9	16
SSW	3	8	6	7	4	9	10	16	10	15	9	17	11	19
SW	11	9	9	10	10	12	10	16	8	17	7	17	9	21
WSW	7	9	17	12	17	15	13	19	12	19	8	18	5	21
W	11	9	12	12	14	15	10	16	8	15	9	17	8	17
WNW	1	8	3	7	5	10	5	14	5	14	5	13	5	13
NW	4	5	3	7	4	8	3	9	3	16	4	14	4	18
NNW	2	5	1	8	3	8	2	10	3	10	2	14	4	16
Calm	15	-	3	-	1	-	1	-	1	-	1	-	-	-
Av. Vel.		5.4		9.2		11.6		13.6		14.5		15.9		16.8
No. Obs.	1203		1203		1163		985		725		512		314	
Autumn - (September - November)														
N	8	3	2	5	2	6	2	8	2	17	3	23	3	30
NNE	3	5	2	5	1	6	2	11	2	11	3	16	1	26
NE	9	5	4	8	2	8	3	11	3	13	3	17	3	24
ENE	7	6	19	13	8	12	6	19	5	22	2	16	3	14
E	16	6	26	14	17	17	10	21	6	23	3	19	2	13
ESE	3	6	16	12	19	18	10	18	5	18	5	19	4	19
SE	5	5	6	12	13	16	7	14	7	16	6	17	5	19
SSE	1	5	4	9	6	12	6	14	8	16	8	19	6	18
S	4	4	2	7	5	13	10	17	11	16	10	17	8	19
SSW	1	4	1	7	5	13	15	21	14	21	12	20	12	21
SW	4	6	4	9	5	15	10	19	12	22	14	26	13	28
WSW	2	6	5	12	7	17	6	20	10	21	12	24	12	27
W	5	5	4	12	5	17	6	17	6	19	8	21	13	22
WNW	1	5	2	9	3	11	4	17	4	20	4	20	5	22
NW	5	3	1	7	1	9	2	12	2	20	4	22	5	24
NNW	2	5	1	8	1	8	1	11	3	15	2	26	5	23
Calm	24	-	1	-	-	-	-	-	-	-	1	-	-	-
Av. Vel.		4.0		11.6		15.0		17.4		19.0		20.6		22.8
No. Obs.	1272		1271		1219		1016		733		471		282	

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Table 37

Percentage Frequency and Average Velocity (m.p.h.)
of Upper Air Winds for Mt. Evans, Greenland

Level	Surface		1600 ft.		3300 ft.		6600 ft.		9000 ft.		13,100 ft.	
Direction	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.
Winter - (December - February)												
N	5	6	2	9	5	13	4	12	2	14	4	13
NNE	3	3	6	12	7	13	3	14	4	16	2	24
NE	14	6	8	12	6	16	3	15	3	13	5	32
ENE	19	7	11	10	7	9	7	16	3	24	-	-
E	15	9	11	13	5	9	4	12	2	9	1	14
ESE	8	18	16	16	4	7	4	20	4	17	6	14
SE	7	20	14	21	11	21	9	28	12	26	11	16
SSE	8	22	11	21	22	25	19	30	16	25	11	24
S	2	14	6	17	13	20	21	28	18	31	19	26
SSW	2	13	5	9	10	16	11	21	13	21	9	30
SW	4	6	-	-	3	12	5	14	8	16	11	22
WSW	1	10	4	8	2	13	2	13	6	10	9	12
W	3	15	2	22	2	9	3	13	3	10	7	17
WNW	1	6	2	6	1	10	2	12	2	13	1	9
NW	2	6	-	-	1	9	1	6	2	6	2	13
NNW	5	8	2	6	1	18	2	14	2	12	2	25
Calm	1	-	-	-	-	-	-	-	-	-	-	-
No. Obs.	199		199		197		175		130		89	
Spring - (March - May)												
N	4	9	5	10	4	17	4	7	4	22	3	29
NNE	8	9	9	13	9	9	4	16	-	-	-	-
NE	6	7	6	8	10	10	2	6	1	12	1	12
ENE	14	8	10	8	6	7	2	13	1	16	-	-
E	15	9	10	10	5	9	5	14	1	10	1	9
ESE	10	10	13	11	5	12	5	9	2	21	3	22
SE	7	17	9	21	12	15	7	15	9	21	7	26
SSE	8	16	9	21	14	16	12	24	13	25	14	29
S	7	13	7	21	16	21	20	25	24	25	20	32
SSW	1	6	4	9	7	13	13	21	24	28	16	30
SW	2	15	4	9	3	8	6	15	4	24	4	25
WSW	3	6	2	8	3	6	6	9	3	21	2	26
W	2	15	4	13	2	10	2	12	4	16	3	24
WNW	4	8	2	8	2	5	1	6	4	12	8	22
NW	4	8	3	6	1	5	3	8	4	16	6	28
NNW	5	8	3	13	1	6	3	6	2	26	4	30
Calm	-	-	-	-	-	-	-	-	-	-	-	-
No. Obs.	226		226		224		202		165		116	

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Table 37 (cont.)

Percentage Frequency and Average Velocity (m.p.h.)
of Upper Air Winds for Mt. Evans, Greenland

Level	Surface		1600 ft.		3300 ft.		6600 ft.		9800 ft.		13,100 ft.	
Direction	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.
Summer - (June - August)												
N	6	12	7	14	9	9	7	9	4	5	4	12
NNE	3	8	6	7	18	10	7	10	8	12	7	10
NE	5	9	9	8	10	9	9	10	3	13	1	21
ENE	13	10	17	9	7	10	3	8	1	9	-	-
E	23	9	15	12	6	7	7	7	3	9	2	5
ESE	14	9	11	9	4	16	4	7	6	10	3	10
SE	8	9	7	9	10	12	5	13	13	13	11	16
SSE	4	14	4	8	6	15	8	14	9	13	11	15
S	8	20	7	24	11	16	15	16	13	16	12	20
SSW	4	14	4	21	5	20	15	17	12	16	16	17
SW	1	12	2	7	2	12	6	12	9	12	6	14
WSW	1	12	1	16	1	8	5	10	6	9	9	23
W	3	15	5	12	4	8	3	5	4	10	8	13
WNW	2	13	2	14	1	9	-	-	2	7	2	10
NW	2	8	2	12	2	3	2	13	3	8	8	15
NNW	3	12	1	2	4	7	4	9	4	14	-	-
Calm	-	-	-	-	-	-	-	-	-	-	-	-
No. Obs.	178		178		170		150		109		90	
Autumn - (September - November)												
N	1	7	2	15	2	12	4	12	4	9	6	21
NNE	2	12	3	7	8	12	6	17	6	10	4	16
NE	7	8	9	9	7	10	2	16	3	8	3	12
ENE	23	8	14	9	6	8	4	10	3	10	5	16
E	24	8	20	9	5	7	3	6	3	15	7	12
ESE	15	10	17	12	5	9	9	17	8	17	5	22
SE	4	14	14	15	12	10	9	15	12	16	7	22
SSE	4	14	6	15	16	18	11	17	15	22	11	22
S	5	21	4	31	16	16	14	20	15	23	18	28
SSW	2	8	3	13	10	14	15	23	7	13	10	18
SW	1	22	4	14	4	16	8	21	9	15	8	14
WSW	1	10	1	7	4	6	7	17	3	21	5	10
W	2	2	1	7	1	9	4	9	2	8	3	12
WNW	-	-	1	9	2	13	2	13	2	8	4	14
NW	1	9	-	-	1	7	1	14	3	9	3	10
NNW	2	6	1	7	1	7	1	9	5	13	1	21
Calm	1	-	-	-	-	-	-	-	-	-	-	-
No. Obs.	165		165		163		148		121		101	

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Table 38

Percentage Frequency and Average Velocity (m.p.h.)
of Upper Air Winds for Mygbukta, Greenland

Level	Surface		1600 ft.		3300 ft.		6600 ft.		9800 ft.		13,100 ft.	
Direction	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.
	Summer - (June 10, 1927 - August 10, 1927)											
N	-	-	5	5	6	7	9	8	7	6	7	17
NNE	-	-	3	2	-	-	-	-	-	-	3	5
NE	-	-	6	8	8	5	6	7	-	-	7	6
ENE	-	-	3	2	-	-	3	9	3	2	-	-
E	3	2	6	7	3	7	3	5	-	-	3	2
ESE	3	7	3	5	-	-	-	-	-	-	3	7
SE	71	5	6	6	3	14	-	-	3	12	3	18
SSE	-	-	3	2	3	7	-	-	-	-	-	-
S	5	2	6	6	-	-	6	18	7	17	7	10
SSW	-	-	8	7	3	12	-	-	7	22	-	-
SW	6	5	11	3	8	5	9	14	6	17	10	17
WSW	-	-	6	5	14	8	6	12	6	18	10	17
W	-	-	-	-	6	8	9	12	-	-	-	-
WNW	-	-	3	5	-	-	11	13	6	6	3	14
NW	6	3	25	7	37	8	29	9	42	12	34	12
NNW	3	5	3	7	9	9	6	17	10	16	10	21
Calm	3	-	-	-	-	-	3	--	3	-	-	-
No. Obs.	35		35		35		34		31		30	

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Table 39

Percentage Frequency and Average Velocity (m.p.h.)
of Upper Air Winds for Nome, Alaska

Level	Surface		1600 ft.		3300 ft.		6600 ft.		9800 ft.		13,100 ft.		16,400 ft.	
Direction	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.
Winter - (December - February)														
N	12	6	7	10	10	14	13	20	8	23	8	23	5	23
NNE	14	10	9	14	9	16	10	23	10	30	6	26	4	35
NE	17	11	12	16	15	20	11	28	9	29	4	21	6	28
ENE	17	10	17	20	16	23	9	26	5	29	3	10	5	16
E	8	8	17	23	11	24	7	25	5	26	7	22	6	26
ESE	2	4	8	23	7	21	7	24	6	21	4	22	2	37
SE	1	8	3	20	4	21	5	20	5	17	4	20	4	17
SSE	1	5	2	19	2	26	3	23	4	21	5	18	2	19
S	2	8	1	9	2	19	3	18	3	19	3	28	4	26
SSW	1	8	1	15	1	12	2	13	4	21	5	22	5	28
SW	1	6	2	10	2	15	2	16	3	18	7	19	6	20
WSW	1	10	2	14	2	21	3	20	5	17	5	20	9	23
W	2	10	4	15	3	14	3	17	6	20	11	23	11	26
WNW	4	6	5	14	4	20	5	22	6	22	11	22	11	17
NW	4	6	5	11	5	12	8	20	12	22	11	25	11	21
NNW	6	7	5	10	7	15	9	20	9	27	8	20	8	30
Calm	7	-	-	-	-	-	-	-	-	-	-	-	1	-
Av. Vel.		8.3		17.0		19.2		22.1		23.5		21.9		23.5
No. Obs.	1056		1055		965		731		444		229		106	
Spring - (March - May)														
N	8	7	6	7	7	13	7	17	5	19	7	19	7	15
NNE	12	12	6	8	7	12	6	20	7	18	4	18	4	19
NE	14	10	12	14	12	14	9	17	7	15	5	19	5	18
ENE	16	10	13	16	12	19	9	18	6	18	4	22	3	11
E	10	11	18	19	13	17	11	19	9	20	10	16	7	17
ESE	3	8	13	20	12	19	9	18	8	17	7	21	7	14
SE	3	6	5	19	8	18	9	20	10	19	4	16	5	18
SSE	1	6	2	17	3	17	5	17	4	15	8	14	7	15
S	2	6	1	8	3	11	4	14	5	15	5	15	7	17
SSW	2	6	2	12	2	24	2	12	3	15	5	16	6	19
SW	3	6	2	12	2	15	2	13	3	17	4	12	6	17
WSW	3	6	2	14	2	12	3	16	4	16	5	20	3	22
W	4	8	2	9	2	15	4	14	7	13	8	18	8	22
WNW	4	8	4	9	3	12	4	16	7	20	7	24	6	20
NW	5	5	5	9	6	12	8	17	8	22	9	24	11	22
NNW	2	7	6	9	6	12	8	18	7	19	8	22	7	22
Calm	8	-	1	-	-	-	-	-	-	-	-	-	1	-
Av. Vel.		8.3		14.3		15.7		17.4		17.7		18.8		17.9
No. Obs.	1051		1051		975		744		501		332		214	

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Table 39 (cont.)

Percentage Frequency and Average Velocity (m.p.h.)
of Upper Air Winds for Nome, Alaska

Level	Surface		1600 ft.		3300 ft.		6600 ft.		9800 ft.		13,100 ft.		16,400 ft.	
Direction	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.
Summer - (June - August)														
N	5	7	6	9	7	10	8	13	6	16	7	20	5	23
NNE	4	11	4	12	9	11	7	12	10	13	9	14	9	20
NE	6	9	5	11	7	11	6	12	7	10	7	15	7	13
ENE	5	8	7	12	6	14	6	13	6	14	5	17	6	17
E	4	8	10	15	8	15	8	15	6	15	7	14	8	15
ESE	6	8	9	13	9	15	10	18	9	18	7	17	9	20
SE	6	7	7	11	8	14	10	18	10	19	7	21	6	19
SSE	4	7	4	11	5	11	5	14	5	14	5	20	6	19
S	4	7	5	10	4	9	5	14	3	19	3	15	4	18
SSW	6	6	4	9	3	11	3	14	3	17	3	14	1	16
SW	7	8	5	11	5	12	3	11	3	15	6	13	7	15
WSW	11	8	5	11	3	14	5	15	5	16	6	14	4	12
W	12	10	7	10	6	13	5	13	4	13	4	18	8	15
WNW	6	8	8	12	6	11	5	15	6	14	6	18	6	16
NW	5	7	8	10	6	10	6	15	8	18	9	20	7	22
NNW	4	7	5	11	7	11	8	15	8	20	8	20	6	23
Calm	5	-	1	-	1	-	-	-	1	-	1	-	1	-
Av. Vel.		7.8		11.4		12.1		14.5		15.7		16.8		17.7
No. Obs.	940		939		821		611		475		355		204	
Autumn - (September - November)														
N	14	7	11	12	12	14	11	17	13	22	8	30	8	30
NNE	13	9	10	12	11	14	12	19	9	22	12	22	8	26
NE	15	8	10	14	13	15	13	21	12	20	7	23	7	25
ENE	12	10	12	18	11	18	7	18	5	17	6	18	6	16
E	5	10	12	20	8	17	7	17	7	18	6	17	6	13
ESE	3	9	6	20	6	20	6	21	7	17	7	18	3	18
SE	1	8	3	13	3	20	4	17	3	17	3	14	2	14
SSE	1	9	2	12	2	12	3	11	2	15	1	21	4	20
S	2	10	2	15	1	17	11	10	1	14	5	16	6	19
SSW	1	10	2	15	2	11	1	18	3	17	4	11	7	18
SW	3	12	3	15	2	13	2	12	2	16	2	20	7	26
WSW	2	8	2	11	3	14	3	17	5	17	7	18	6	23
W	2	9	3	10	3	14	3	15	4	16	6	18	7	20
WNW	5	9	6	16	5	15	4	15	6	16	7	18	6	16
NW	8	8	8	14	8	14	10	17	10	17	6	22	8	16
NNW	10	8	8	14	10	15	13	20	11	25	13	23	9	25
Calm	3	-	-	-	-	-	-	-	-	-	-	-	-	-
Av. Vel.		8.5		15.2		15.4		17.9		19.0		20.1		21.3
No. Obs.	1186		1186		1064		703		475		295		160	

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Table 40

Percentage Frequency and Average Velocity (m.p.h.)
of Upper Air Winds for Port Harrison, Canada

Level	Surface		1600 ft.		3300 ft.		6600 ft.		9800 ft.		13,100 ft.	
Direction	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.
Winter - (December - February)												
N	18	16	9	16	12	21	16	23	17	25	19	26
NNE	-	-	7	22	9	16	4	27	10	16	7	17
NE	12	13	7	19	4	4	16	17	-	-	4	20
ENE	3	11	7	20	7	13	-	-	3	34	7	25
E	3	4	-	-	4	13	3	9	3	20	4	22
ESE	3	9	3	25	-	-	-	-	-	-	-	-
SE	-	-	-	-	-	-	-	-	-	-	4	4
SSE	6	9	4	22	12	18	3	31	-	-	-	-
S	9	7	7	16	4	27	3	16	10	15	-	-
SSW	3	13	-	-	-	-	7	9	4	25	7	30
SW	6	11	12	15	-	-	-	-	4	20	4	34
WSW	-	-	12	18	12	17	3	16	-	-	3	4
W	10	7	7	9	9	23	17	26	8	24	4	13
WNW	-	-	7	12	3	11	-	-	10	33	11	47
NW	15	13	9	19	12	21	16	20	17	35	22	41
NNW	3	22	9	24	12	22	12	30	10	39	4	40
Calm	9	-	0	-	0	-	0	-	4	-	0	-
No. Obs.	33		33		33		31		29		27	
Spring - (March - May)												
N	8	10	3	9	3	11	8	19	14	27	19	28
NNE	-	-	5	16	5	13	6	21	3	20	-	-
NE	8	15	8	20	3	29	3	29	6	24	3	34
ENE	3	22	-	-	5	13	6	30	6	18	3	16
E	14	10	5	13	8	23	3	7	-	-	-	-
ESE	-	-	3	25	-	-	3	11	-	-	-	-
SE	5	14	8	13	-	-	3	9	3	18	3	29
SSE	-	-	11	16	5	17	8	13	6	9	3	4
S	24	13	8	24	8	13	-	-	-	-	11	14
SSW	-	-	10	26	16	20	6	8	6	10	-	-
SW	14	17	-	-	-	-	6	14	6	22	-	-
WSW	-	-	10	21	3	20	8	22	2	9	3	13
W	16	15	11	26	22	24	23	22	26	30	26	30
WNW	-	-	10	21	11	22	6	27	14	23	13	29
NW	3	11	5	14	3	16	8	14	8	10	13	21
NNW	-	-	3	16	8	14	3	31	-	-	3	36
Calm	5	-	-	-	-	-	-	-	-	-	-	-
No. Obs.	37		37		37		35		35		31	

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Table 40 (cont.)

Percentage Frequency and Average Velocity (m.p.h.)
of Upper Air Winds for Port Harrison, Canada

Level	Surface		1600 ft.		3300 ft.		6600 ft.		9800 ft.		13,100 ft.	
Direction	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.
Summer - (June - August)												
N	16	18	16	16	8	20	11	14	9	16	7	17
NNE	-	-	3	16	3	27	6	18	3	7	-	-
NE	8	11	-	-	3	4	-	-	-	-	-	-
ENE	-	-	-	-	3	4	-	-	-	-	-	-
E	-	-	6	9	3	22	3	25	-	-	-	-
ESE	-	-	3	16	5	10	-	-	-	-	-	-
SE	-	-	8	13	8	11	3	27	-	-	-	-
SSE	-	-	3	11	3	25	8	15	9	19	7	18
S	27	12	8	20	8	22	3	7	6	19	7	16
SSW	-	-	8	17	3	16	6	8	3	11	4	20
SW	30	13	6	19	5	17	3	7	6	14	4	18
WSW	-	-	11	23	10	17	17	17	12	22	14	25
W	16	15	3	20	5	20	6	30	9	22	14	24
WNW	-	-	8	17	11	17	13	24	15	33	21	26
NW	3	25	17	17	11	20	13	22	19	21	11	16
NNW	-	-	-	-	11	15	8	18	9	22	11	14
Calm	-	-	-	-	-	-	-	-	-	-	-	-
No. Obs.	37		37		37		36		35		28	
Autumn - (Insufficient data)												

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Table 40 (cont.)

Percentage Frequency and Average Velocity (m.p.h.)
of Upper Air Winds for Port Harrison, Canada

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.#	Oct.#	Nov.	Dec.
Surface												
Prev. Dir.	NE	NW	E	*	S	*	S	*			*	*
Av. Vel.	9.8	12.5	11.0	15.9	13.4	9.2	17.2	13.2			17.9	9.2
1600 Feet												
Prev. Dir.	NE	WSW	SE	*	SSW	*	NW	*			*	*
Av. Vel.	20.1	17.2	16.1	22.4	22.6	14.1	18.6	14.8			28.6	16.3
3300 Feet												
Prev. Dir.	NNE	NNW	W	*	SSW	*	N	*			*	*
Av. Vel.	19.0	19.0	14.5	27.7	21.7	15.7	18.6	15.0			27.3	15.9
6600 Feet												
Prev. Dir.	NE	NW	W	*	SW	*	NW	*			*	*
Av. Vel.	23.0	22.8	16.8	29.3	17.4	19.2	19.0	15.4			42.5	13.9
9800 Feet												
Prev. Dir.	NNW	NW	W	*	SSW	*	NW	*			*	*
Av. Vel.	23.9	30.4	20.1	35.8	16.8	23.0	21.0	18.3			44.1	17.9
13,100 Feet												
Prev. Dir.	NW	NW	N	*	S	*	W	*			*	*
Av. Vel.	23.5	37.6	24.2	54.1	15.7	18.3	20.6	23.3			49.2	23.5

*Less than 10 observations. (Unusually high averages mostly from few observations.)

#No data available.

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Table 41

Percentage Frequency and Average Velocity (m.p.h.)
of Upper Air Winds for Reykjavik, Iceland

Level	Surface		1600 ft.		3300 ft.		6600 ft.		9800 ft.		13,100 ft.	
Direction	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.
Winter - (December - February)												
N	9	9	7	8	8	9	8	14	13	20	16	23
NNE	8	13	5	9	7	9	9	14	8	22	5	22
NE	5	12	8	14	9	14	7	22	8	24	10	21
ENE	8	15	9	13	10	13	10	18	7	13	5	20
E	25	21	22	22	16	16	5	9	7	17	5	9
ESE	5	13	10	16	9	23	10	18	10	18	9	18
SE	9	21	10	18	16	18	11	22	5	22	4	23
SSE	3	7	6	8	7	16	7	16	7	20	5	15
S	4	10	1	15	1	7	4	29	3	13	-	-
SSW	1	12	2	12	1	31	1	14	-	-	5	16
SW	3	14	4	18	4	17	1	22	3	18	4	22
WSW	3	17	6	12	1	29	4	12	3	18	3	14
W	3	10	4	8	3	10	6	20	7	25	9	33
WNW	3	12	1	12	2	7	5	15	6	23	10	22
NW	3	6	1	10	3	15	5	21	6	16	5	16
NNW	5	7	4	6	3	10	7	10	7	15	5	22
Calm	3	-	-	-	-	-	-	-	-	-	-	-
No. Obs.	147		143		117		83		68		58	
Spring - (March - May)												
N	9	9	7	8	8	9	8	14	13	20	16	23
NNE	8	13	5	9	7	9	9	14	8	22	5	22
NE	5	12	8	14	9	14	7	22	8	24	10	21
ENE	8	15	9	13	10	13	10	18	7	13	5	20
E	25	21	22	22	16	16	5	9	7	17	5	9
ESE	5	13	10	16	9	23	10	18	10	18	9	18
SE	9	21	10	18	16	18	11	22	5	22	4	23
SSE	3	7	6	8	7	16	7	16	7	20	5	15
S	4	10	1	15	1	7	4	29	3	13	-	-
SSW	1	12	2	12	1	31	1	14	-	-	5	16
SW	3	14	4	18	4	17	1	22	3	18	4	22
WSW	3	17	6	12	1	29	4	12	3	18	3	14
W	3	10	4	8	3	10	6	20	7	25	9	33
WNW	3	12	1	12	2	7	5	15	6	23	10	22
NW	3	6	1	10	3	15	5	21	6	16	5	16
NNW	5	7	4	6	3	10	7	10	7	15	5	22
Calm	3	-	-	-	-	-	-	-	-	-	-	-
No. Obs.	147		143		117		83		68		58	

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Table 41 (cont.)

Percentage Frequency and Average Velocity (m.p.h.)
of Upper Air Winds for Reykjavik, Iceland

Level	Surface		1600 ft.		3300 ft.		6600 ft.		9800 ft.		13,100 ft.	
Direction	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.
Summer - (June - August)												
N	8	13	9	14	11	11	11	16	18	22	15	25
NNE	6	16	5	15	12	15	15	14	6	14	8	16
NE	1	9	1	5	9	10	11	16	14	16	16	15
ENE	5	6	7	7	7	9	4	12	6	16	1	21
E	5	12	4	13	6	14	4	12	3	12	4	14
ESE	3	14	4	10	5	12	4	16	4	17	5	18
SE	8	15	9	18	4	13	7	15	3	21	2	28
SSE	5	9	6	14	4	14	2	25	3	15	-	-
S	4	17	6	16	5	21	2	8	1	14	4	17
SSW	6	13	4	10	3	9	6	15	3	13	5	18
SW	4	17	7	16	10	17	4	17	4	14	2	8
WSW	7	9	7	13	3	14	3	15	7	12	5	13
W	6	8	8	12	5	14	5	21	4	12	2	18
WNW	12	9	6	7	4	12	3	17	6	23	12	17
NW	8	8	6	8	3	12	11	10	7	22	7	24
NNW	10	12	10	13	8	9	8	14	11	15	12	21
Calm	2	-	1	-	1	-	-	-	-	-	-	-
No. Obs.	167		138		128		102		91		83	
Autumn - (September - November)												
N	14	14	16	13	10	10	8	24	9	29	13	35
NNE	10	16	17	14	15	15	15	15	9	17	6	21
NE	6	12	2	5	10	9	8	14	16	16	9	16
ENE	9	12	16	12	10	15	13	15	9	12	13	17
E	14	13	5	18	6	15	5	9	5	14	5	15
ESE	7	14	10	12	7	15	6	10	4	6	5	14
SE	7	12	5	9	11	16	5	23	7	12	5	9
SSE	3	17	-	-	3	7	2	16	1	14	2	18
S	5	14	3	14	-	-	2	15	3	12	-	-
SSW	3	18	5	22	5	15	4	17	3	21	3	12
SW	5	12	6	17	6	21	7	21	1	21	2	29
WSW	2	5	3	3	4	8	4	12	4	10	6	22
W	1	5	2	2	1	7	1	2	7	14	5	23
WNW	-	-	-	-	3	8	4	12	3	23	8	24
NW	3	7	8	6	-	-	5	13	10	23	10	21
NNW	8	7	2	9	8	12	11	21	9	23	8	25
Calm	3	-	-	-	1	-	-	-	-	-	-	-
No. Obs.	80		62		89		84		76		62	

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Table 42

Percentage Frequency and Average Velocity (m.p.h.) of Upper Air Winds for Tikhaja, Franz Joseph Land

Level	Surface		1600 ft.		3300 ft.		6600 ft.		9800 ft.		13,100 ft.	
Direction	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.
					Winter - (January - February)							
N	17		12		12		11		11		5	
NNE	7		10		9		13		8		5	
NE	4		11		10		8		4		5	
ENE	2		10		10		8		15		11	
E	10		15		8		12		8		16	
ESE	2		4		6		1		4		5	
SE	1		2		2		3		-		-	
SSE	1		5		1		1		2		-	
S	2		5		8		1		2		-	
SSW	-		-		5		1		-		5	
SW	1		4		3		-		7		6	
WSW	1		5		2		4		2		5	
W	2		2		7		5		6		-	
WNW	1		4		2		3		8		5	
NW	1		4		5		12		15		21	
NNW	1		4		9		14		8		11	
Calm	47	-	3	-	1	-	3	-	-	-	-	-
Av. Vel.		6		13		16		16		16		17
No. Obs.		126		118		103		75		48		19
					Spring - (March - May)							
N	11		8		12		13		16		10	
NNE	5		8		5		9		3		3	
NE	3		10		6		4		6		3	
ENE	3		8		7		7		8		8	
E	16		15		19		17		13		19	
ESE	6		5		7		8		8		6	
SE	6		9		8		4		5		2	
SSE	2		6		7		6		3		4	
S	1		8		5		4		4		5	
SSW	2		3		1		4		2		2	
SW	1		2		3		1		3		3	
WSW	-		2		3		3		3		1	
W	2		3		3		6		8		5	
WNW	1		1		3		1		8		5	
NW	1		2		2		5		3		9	
NNW	1		3		5		4		4		11	
Calm	39	-	7	-	4	-	4	-	3	-	4	-
Av. Vel.		8		14		15		16		16		17
No. Obs.		250		214		167		142		119		99

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Table 42 (cont.)

Percentage Frequency and Average Velocity (m.p.h.)
of Upper Air Winds for Tikhaja, Franz Joseph Land

Level	Surface		1600 ft.		3300 ft.		6600 ft.		9800 ft.		13,100 ft.	
Direction	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.
Summer - (June - August)												
N	14		5		4		5		11		11	
NNE	5		5		2		3		-		2	
NE	2		4		3		4		4		2	
ENE	1		4		7		5		7		2	
E	12		15		16		15		19		13	
ESE	5		7		6		10		2		11	
SE	4		5		6		5		9		6	
SSE	4		5		4		5		4		4	
S	1		7		4		8		9		9	
SSW	1		5		4		3		2		4	
SW	4		6		6		5		4		2	
WSW	2		5		4		6		2		-	
W	4		2		14		6		13		13	
WNW	2		9		4		6		4		9	
NW	7		4		7		2		4		2	
NNW	-		5		5		8		4		6	
Calm	32		7		4		4		2		4	
Av. Vel.		7		13		14		17		17		17
No. Obs.		200		132		116		79		53		47
Autumn - (September - November)												
N	6		11		11		2		14		25	
NNE	11		6		10		12		7		13	
NE	6		9		10		14		14		6	
ENE	8		12		8		12		-		-	
E	12		17		19		9		7		6	
ESE	2		3		3		12		7		6	
SE	3		6		8		2		11		13	
SSE	4		5		5		2		-		-	
S	-		8		2		2		-		-	
SSW	-		1		2		2		-		-	
SW	-		2		-		-		-		-	
WSW	-		-		2		12		3		6	
W	-		2		3		2		7		19	
WNW	1		5		6		12		11		-	
NW	1		-		5		5		11		6	
NNW	1		5		6		-		4		-	
Calm	45		8		-		-		4		-	
Av. Vel.		5		12		15		16		18		18
No. Obs.		73		64		62		43		28		16

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Table 43

Percentage Frequency and Average Velocity (m.p.h.)
of Upper Air Winds for Tiksi Bay, Siberia

Level	Surface		1600 ft.		3300 ft.		6600 ft.		9800 ft.		13,100 ft.	
Direction	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.
Winter - (December - February)												
N	-		1		3		3		-		-	
NNE	-		-		2		-		-		-	
NE	1		1		-		3		-		-	
ENE	-		-		3		-		-		-	
E	-		1		3		3		5		-	
ESE	-		6		4		3		-		19	
SE	-		6		8		-		6		18	
SSE	-		3		8		16		5		9	
S	-		11		20		16		21		18	
SSW	8		12		10		3		21		9	
SW	21		14		12		26		5		18	
WSW	6		13		8		10		21		-	
W	6		11		8		3		-		9	
WNW	2		1		3		3		-		-	
NW	1		1		1		-		6		-	
NNW	-		1		-		4		5		-	
Calm	55	-	13	-	7	-	7	-	5	-	-	-
Av. Vel.		6		11		10		11		14		14
No. Obs.		95		93		72		31		19		11
Spring - (March - May)												
N	2		3		4		4		5		11	
NNE	2		3		1		3		4		6	
NE	7		4		4		6		3		-	
ENE	1		4		2		2		2		6	
E	3		5		7		6		5		9	
ESE	-		10		6		9		7		6	
SE	1		13		16		7		7		2	
SSE	-		8		11		7		9		9	
S	2		5		4		11		9		9	
SSW	4		4		5		7		10		11	
SW	7		6		8		9		2		9	
WSW	4		6		4		9		9		4	
W	2		16		15		7		12		6	
WNW	2		2		5		5		9		3	
NW	3		2		1		1		2		2	
NNW	1		2		1		2		3		2	
Calm	59	-	7	-	6	-	5	-	2	-	-	-
Av. Vel.		4		12		15		15		16		18
No. Obs.		115		103		96		82		57		47

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Table 43 (cont.)

Percentage Frequency and Average Velocity (m.p.h.)
of Upper Air Winds for Tiksi Bay, Siberia

Level	Surface		1600 ft.		3300 ft.		6600 ft.		9800 ft.		13,100 ft.	
Direction	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.
Summer - (June - August)												
N	6		5		5		7		8		7	
NNE	7		-		2		9		8		7	
NE	12		3		4		2		3		7	
ENE	10		7		2		4		6		-	
E	9		4		4		2		6		7	
ESE	2		5		5		9		-		-	
SE	4		8		2		2		5		-	
SSE	-		17		12		2		-		-	
S	-		5		10		7		3		7	
SSW	1		1		4		6		6		-	
SW	6		5		2		4		11		7	
WSW	1		5		7		6		3		10	
W	11		11		19		17		19		17	
WNW	4		9		2		6		14		17	
NW	1		6		10		9		5		7	
NNW	3		4		5		4		3		4	
Calm	23	-	5	-	5	-	4	-	-	-	3	-
Av. Vel.		9		14		14		17		16		19
No. Obs.		82		77		57		47		36		29
Autumn - (September - November)												
N	2		2		2		-		-		-	
NNE	3		2		2		-		-		-	
NE	4		-		-		-		-		-	
ENE	-		3		-		-		7		12	
E	-		4		4		5		-		11	
ESE	2		7		4		6		15		11	
SE	3		2		8		6		7		-	
SSE	1		6		4		11		7		11	
S	2		11		20		28		14		22	
SSW	15		11		12		17		7		-	
SW	22		13		8		-		7		-	
WSW	3		11		10		17		7		11	
W	8		15		16		5		15		22	
WNW	1		5		6		5		7		-	
NW	4		1		-		-		-		-	
NNW	-		2		-		-		-		-	
Calm	30	-	5	-	4	-	-	-	7	-	-	-
Av. Vel.		8		15		19		20		20		15
No. Obs.		99		85		50		18		14		9

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Table 44

Percentage Frequency and Average Velocity (m.p.h.)
of Upper Air Winds for Tromso, Norway

Level	1600 ft.		3300 ft.		6600 ft.		9800 ft.		13,100 ft.	
Direction	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.
Winter - (December - February)										
N	3	14	1	17	6	14	5	-	16	26
NNE	1	6	4	15	2	42	14	22	4	45
NE	4	11	4	17	10	15	7	19	8	18
ENE	3	9	2	12	5	11	2	7	-	-
E	2	5	4	16	6	12	-	-	-	-
ESE	2	4	7	11	-	-	5	11	-	-
SE	1	5	2	16	5	12	2	5	4	10
SSE	7	13	9	11	4	8	5	20	8	11
S	29	21	11	14	10	22	7	22	4	17
SSW	29	18	20	24	8	17	16	22	12	14
SW	10	17	25	18	24	24	9	15	8	27
WSW	2	10	2	9	10	16	14	21	4	32
W	-	-	6	17	-	-	2	11	8	16
WNW	1	19	1	8	2	10	7	11	4	8
NW	5	12	2	10	5	13	-	-	8	6
NNW	1	4	-	-	3	13	5	17	12	15
Calm	-	-	-	-	-	-	-	-	-	-
Av. Vel.	11		14		16		16		19	
No. Obs.	86		88		62		43		25	
Spring - (March - May)										
N	2	6	4	8	3	15	7	20	9	26
NNE	1	8	1	14	7	12	6	16	4	17
NE	4	10	3	9	5	17	6	24	5	36
ENE	4	13	5	12	4	13	6	16	6	20
E	3	8	6	12	5	21	2	20	3	24
ESE	1	6	2	12	4	16	3	17	3	17
SE	2	8	5	10	5	14	5	14	4	20
SSE	13	12	11	14	9	14	7	15	4	10
S	30	13	14	14	11	16	9	15	1	10
SSW	15	16	21	12	14	12	7	21	8	25
SW	16	14	11	15	7	28	11	17	9	20
WSW	6	3	7	12	9	21	7	19	14	17
W	-	-	5	12	10	17	7	19	10	24
WNW	1	10	3	11	5	15	7	18	6	26
NW	1	17	2	12	2	10	7	19	7	24
NNW	1	18	-	-	-	-	3	14	7	24
Calm	-	-	-	-	-	-	-	-	-	-
Av. Vel.	11		12		16		18		21	
No. Obs.	140		168		135		110		98	

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Table 44 (cont.)

Percentage Frequency and Average Velocity (m.p.h.)
of Upper Air Winds for Tromso, Norway

Level	1600 ft.		3300 ft.		6600 ft.		9800 ft.		13,100 ft.	
Direction	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.
Summer - (June - August)										
N	-	-	1	10	-	-	3	9	2	20
NNE	6	11	1	6	1	5	-	-	9	14
NE	8	8	5	9	4	12	4	13	13	12
ENE	8	10	4	9	1	10	8	12	7	15
E	6	9	4	7	9	13	8	8	-	-
ESE	4	7	6	8	8	11	6	10	9	14
SE	13	9	11	10	9	12	8	14	4	13
SSE	10	11	9	13	14	14	9	13	4	18
S	24	14	28	15	9	22	5	14	9	20
SSW	10	13	12	11	10	15	15	18	11	16
SW	7	12	11	11	12	11	5	13	2	39
WSW	3	6	5	10	13	19	11	19	16	15
W	1	5	2	11	6	13	11	12	9	19
WNW	-	-	-	-	3	10	1	29	2	23
NW	-	-	1	8	1	17	1	26	2	14
NNW	-	-	-	-	-	-	5	12	-	-
Calm	-	-	-	-	-	-	-	-	-	-
Av. Vel.		10		10		13		15		18
No. Obs.		71		83		78		65		45
Autumn - (September - November)										
N	-	-	3	10	3	13	-	-	5	5
NNE	5	9	1	15	-	-	10	10	14	14
NE	3	17	6	9	4	13	9	11	-	-
ENE	4	9	1	12	6	18	7	14	7	9
E	3	9	4	8	9	10	7	17	5	14
ESE	3	17	3	8	3	11	2	8	-	-
SE	4	11	7	9	3	26	-	-	-	-
SSE	12	12	10	13	6	15	3	15	5	18
S	26	14	15	19	11	21	2	18	2	17
SSW	15	12	23	16	16	23	10	17	10	28
SW	15	11	14	11	17	14	23	20	10	29
WSW	4	12	5	17	12	10	9	10	7	27
W	2	6	3	13	7	14	3	14	10	11
WNW	1	5	4	9	1	14	4	20	10	13
NW	2	6	1	23	1	21	9	10	10	18
NNW	1	32	-	-	1	9	2	9	5	11
Calm	-	-	-	-	-	-	-	-	-	-
Av. Vel.		12		13		15		14		16
No. Obs.		80		73		70		57		41

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Table 45

Percentage Frequency and Average Velocity (m.p.h.)
of Upper Air Winds for Verkhoyansk, Siberia

Level	Surface*		1600 ft.		3300 ft.		6600 ft.		9800 ft.		13,100 ft.	
Direction	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.		
Winter - (January - February)												
N	2		5		3		-		7			
NNE	-		-		7		-		-			
NE	2		5		-		-		-			
ENE	-		-		3		-		-			
E	-		2		4		4		7			
ESE	2		-		-		-		-			
SE	2		3		-		-		-			
SSE	2		-		3		5		-			
S	5		15		21		24		7			
SSW	46		21		7		5		14			
SW	9		20		10		9		-			
WSW	9		10		7		5		7			
W	-		8		10		-		-			
WNW	-		3		14		5		29			
NW	-		-		3		19		-			
NNW	4		5		4		5		7			
Calm	17		3		4		19		22			
Av. Vel.		9		10		9		12		12		
No. Obs.	46		39		29		21		14			
Spring - (March - May)												
N	8		5		7		3		10			
NNE	11		16		4		13		9			
NE	5		10		6		3		3			
ENE	4		4		8		8		13			
E	6		4		2		8		6			
ESE	1		2		4		3		3			
SE	2		1		4		2		3			
SSE	2		4		2		3		-			
S	22		14		6		-		3			
SSW	6		16		7		8		6			
SW	7		5		8		5		-			
WSW	4		6		8		8		19			
W	3		2		10		13		6			
WNW	-		1		10		16		3			
NW	2		2		6		2		13			
NNW	2		2		6		-		3			
Calm	15		6		2		-		-			
Av. Vel.		9		10		10		12		14		
No. Obs.	95		83		51		36		32			

*No data available.

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Table 45 (cont.)

Percentage Frequency and Average Velocity (m.p.h.) of Upper Air Winds for Verkhoyansk, Siberia

Level	Surface		1600 ft.		3300 ft.		6600 ft.		9800 ft.		13,100 ft.	
Direction	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.
Summer - (June - August)												
N	16		5		3		7		16		11	
NNE	4		22		12		11		7		15	
NE	7		9		9		2		10		-	
ENE	5		-		9		5		-		11	
E	4		11		3		5		3		-	
ESE	-		3		2		-		3		-	
SE	-		5		6		7		-		-	
SSE	-		-		3		5		6		4	
S	3		3		5		11		3		-	
SSW	3		12		6		4		3		-	
SW	9		9		9		4		13		15	
WSW	1		5		9		9		7		11	
W	1		3		4		13		6		7	
WNW	1		1		4		2		-		7	
NW	1		-		2		2		10		-	
NNW	3		-		4		4		3		15	
Calm	42	-	12	-	10	-	9	-	10	-	4	-
Av. Vel.		6		10		11		12		12		13
No. Obs.		76		76		67		45		31		27
Autumn - (September - November)												
N	2		2		4		-		8		10	
NNE	-		8		10		2		-		-	
NE	4		4		2		8		2		-	
ENE	-		2		2		-		3		6	
E	-		-		2		2		11		6	
ESE	-		-		-		8		3		7	
SE	-		2		-		5		3		3	
SSE	-		-		-		-		3		3	
S	-		13		4		5		11		10	
SSW	-		20		27		10		5		3	
SW	10		12		4		10		13		10	
WSW	2		10		12		20		11		3	
W	2		10		13		10		11		23	
WNW	-		-		4		5		11		7	
NW	-		-		2		5		5		3	
NNW	-		-		4		8		-		6	
Calm	80	-	17	-	10	-	2	-	-	-	-	-
Av. Vel.		2		10		12		13		14		16
No. Obs.		51		51		49		40		37		31

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Table 46

Percentage Frequency and Average Velocity (m.p.h.) of Upper Air Winds for Yakutsk, Siberia

Level	Surface		1600 ft.		3300 ft.		6600 ft.		9800 ft.		13,100 ft.	
Direction	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.	%	Vel.
Winter - (December - February)												
N	17		3		3		5		22		17	
NNE	1		-		-		-		-		17	
NE	-		-		-		-		-		-	
ENE	-		1		-		-		-		-	
E	-		1		1		-		-		-	
ESE	-		3		-		3		-		-	
SE	-		1		-		3		-		-	
SSE	-		5		2		-		-		-	
S	-		7		2		-		6		-	
SSW	-		4		4		2		-		-	
SW	3		3		3		10		22		25	
WSW	-		1		3		5		-		-	
W	4		19		22		13		11		-	
WNW	1		13		21		20		22		17	
NW	6		18		24		13		11		16	
NNW	-		14		12		3		6		8	
Calm	68		7		3		3		-		-	
Av. Vel.		3		12		17		18		23		31
No. Obs.		72		74		67		39		18		12
Spring - (March - May)												
N	5		12		19		17		17		16	
NNE	4		3		1		4		12		19	
NE	3		-		2		5		3		7	
ENE	-		2		1		2		5		3	
E	2		6		-		2		2		3	
ESE	-		1		5		3		2		3	
SE	2		4		4		2		3		3	
SSE	-		7		5		5		5		3	
S	2		11		12		5		7		-	
SSW	2		4		-		5		3		-	
SW	2		2		3		5		2		6	
WSW	-		1		5		5		7		6	
W	4		7		9		10		10		6	
WNW	7		10		7		11		3		6	
NW	23		15		12		9		5		3	
NNW	1		13		10		5		12		6	
Calm	43		2		5		5		2		10	
Av. Vel.		6		14		14		15		16		19
No. Obs.		92		92		81		58		41		32

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Table 46 (cont.)

Percentage Frequency and Average Velocity (m.p.h.)
of Upper Air Winds for Yakutsk, Siberia

Level	Surface		1600 ft.		3300 ft.		6600 ft.		9800 ft.		13,100 ft.	
Direction	%	Vel.	%	Vel	%	Vel.	%	Vel.	%	Vel.	%	Vel.
Summer - (June - August)												
N	4		7		8		11		15		13	
NNE	5		5		3		7		8		9	
NE	5		6		3		5		1		4	
ENE	-		2		3		5		1		1	
E	2		5		2		2		6		3	
ESE	2		3		5		1		1		-	
SE	5		2		2		2		1		-	
SSE	4		10		11		6		4		5	
S	3		8		7		7		6		6	
SSW	2		2		4		5		5		-	
SW	-		4		6		9		1		3	
WSW	1		4		4		6		6		1	
W	5		3		6		5		14		19	
WNW	6		8		10		6		8		8	
NW	12		14		12		7		8		12	
NNW	6		8		11		10		12		12	
Calm	38	-	9	-	3	-	6	-	3	-	4	-
Av. Vel.		6		11		12		14		15		16
No. Obs.		128		126		123		108		88		77
Autumn - (September - November)												
N	9		5		6		21		15		13	
NNE	3		5		2		2		7		18	
NE	-		1		1		2		5		-	
ENE	1		2		-		-		-		-	
E	-		2		3		5		2		-	
ESE	-		1		2		1		-		-	
SE	1		4		1		2		2		2	
SSE	3		8		6		-		-		-	
S	7		12		5		4		-		-	
SSW	1		4		10		2		2		3	
SW	1		5		5		8		2		3	
WSW	-		4		6		9		17		2	
W	5		5		8		14		15		20	
WNW	7		12		12		8		13		18	
NW	13		18		13		8		12		13	
NNW	1		10		16		11		8		8	
Calm	48	-	2	-	4	-	3	-	-	-	-	-
Av. Vel.		4		14		15		17		20		21
No. Obs.		152		146		130		91		59		39

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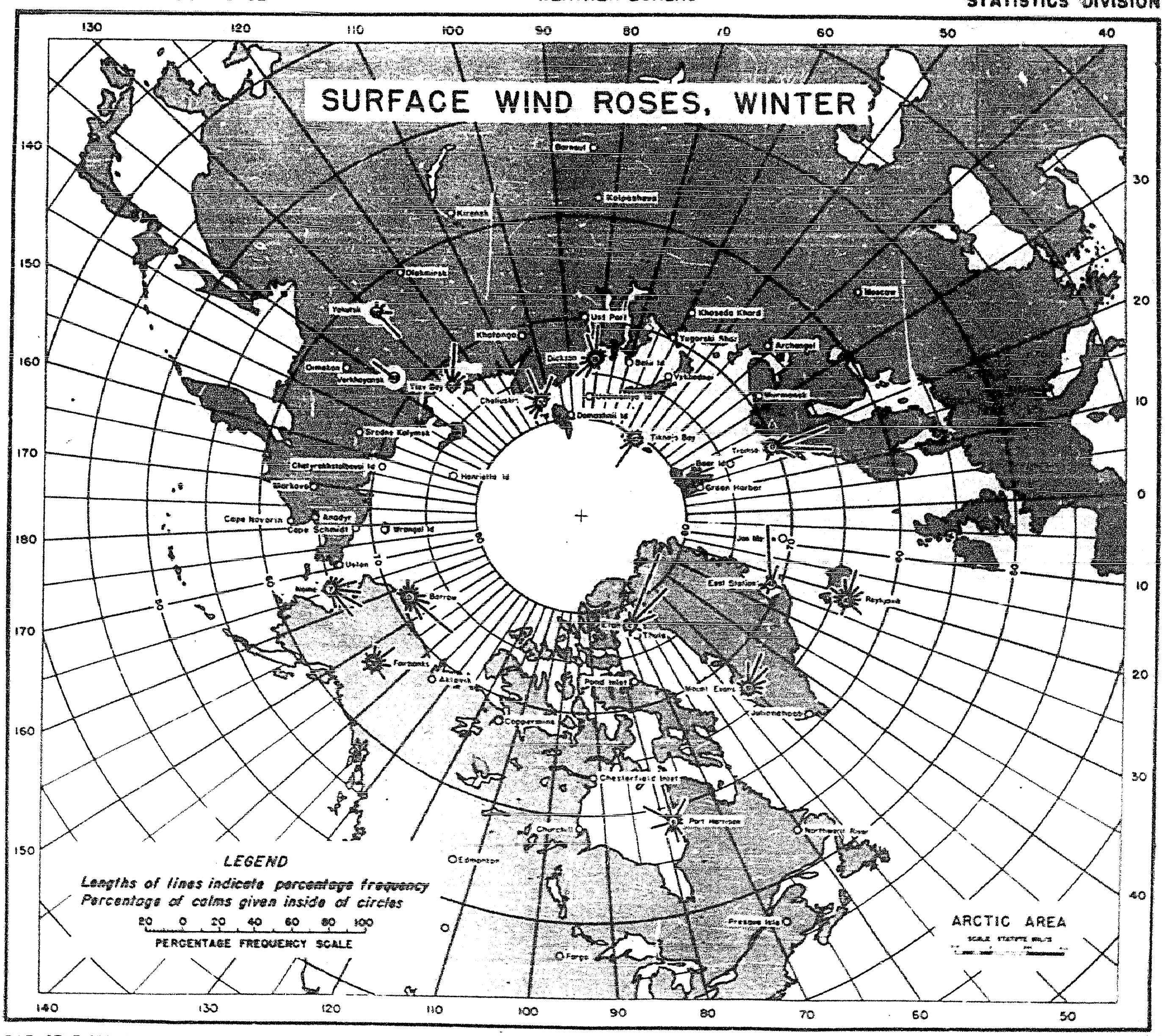

FILE STAT 422424-4   BASE STAT 422086-2   FIGURE

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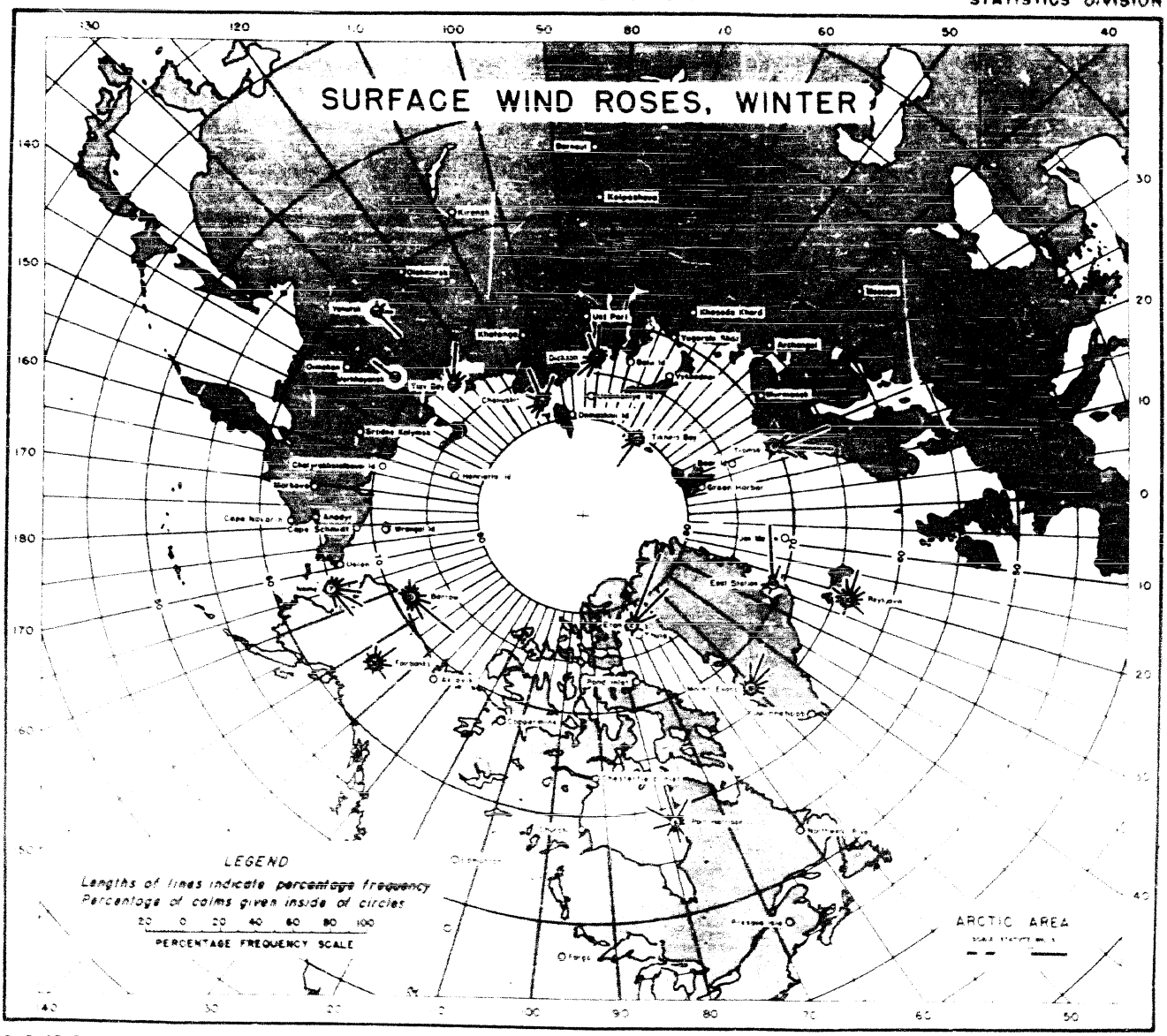
SURFACE WIND ROSES, WINTER
LEGEND
Lengths of lines indicate percentage frequency
Percentage of calms given inside of circles
80 60 40 20 0 20 40 60 80 100
PERCENTAGE FREQUENCY SCALE
ARCTIC AREA

FILE STAT 422424-4 BASE STAT 422086.0 FIGURE

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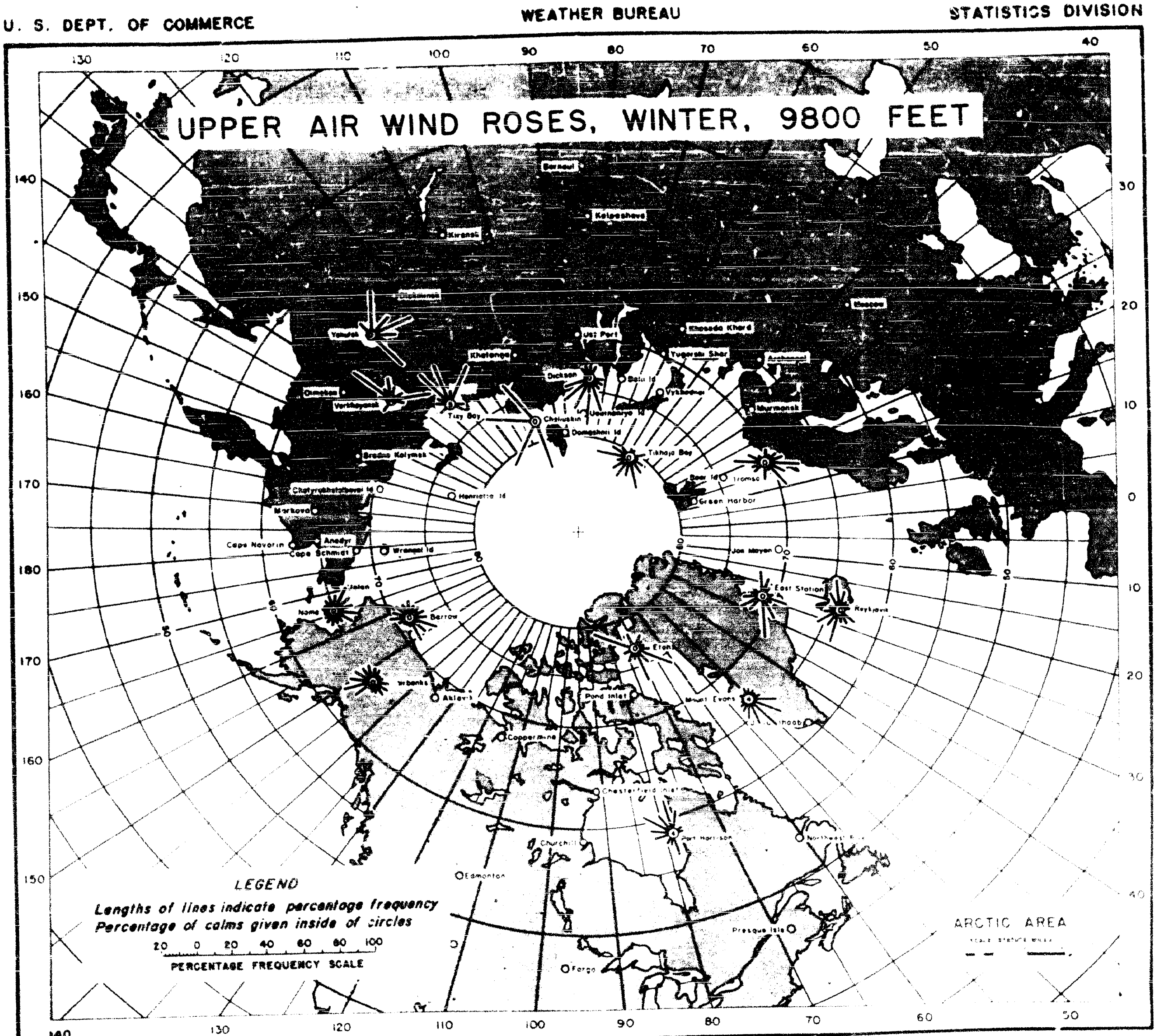
UPPER AIR WIND ROSES, WINTER, 9800 FEET



FIGURE

FILE STAT 422424-5

BASE STAT 422086-2

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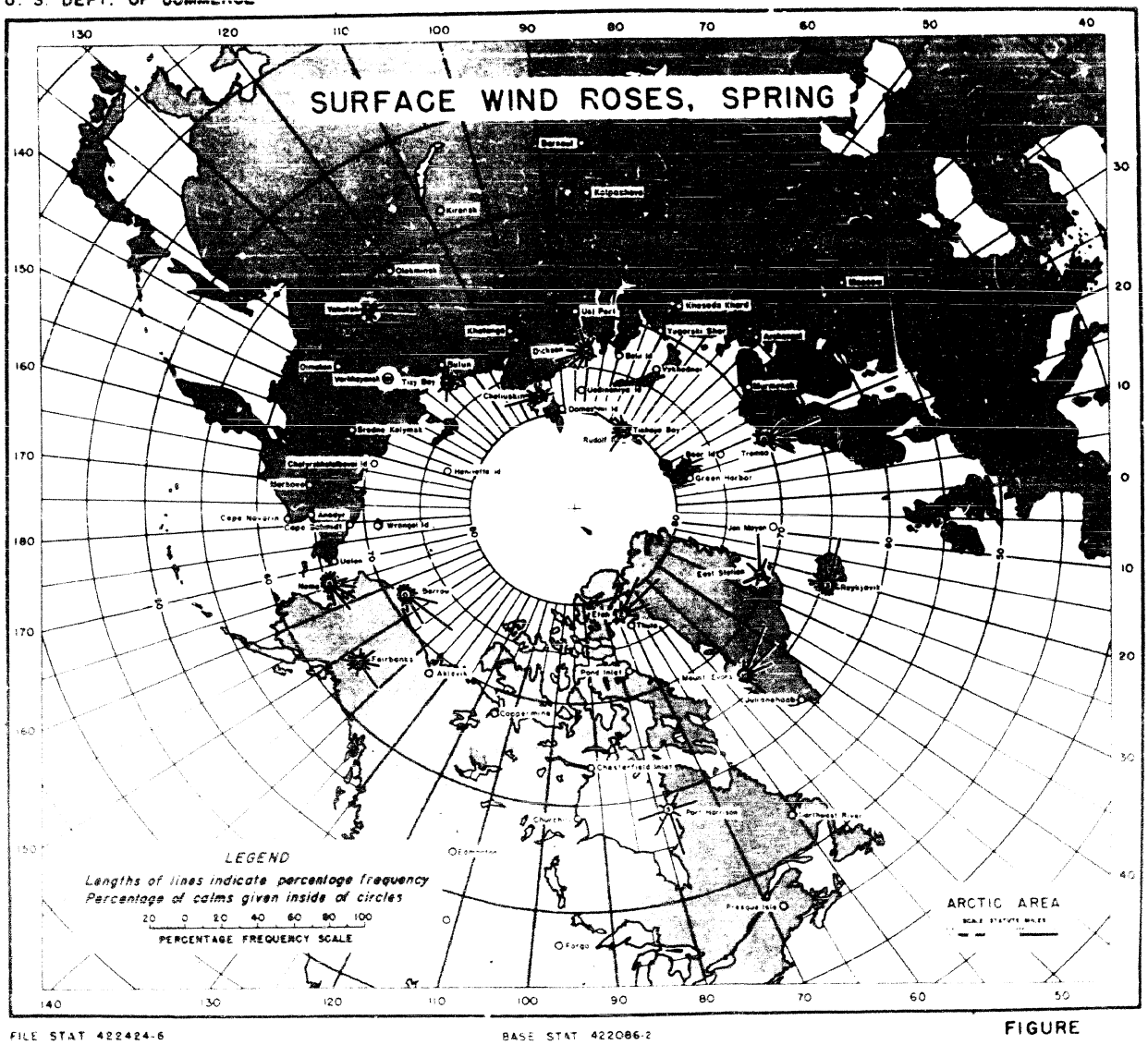
SURFACE WIND ROSES, SPRING
LEGEND
Lengths of lines indicate percentage frequency
Percentage of calms given inside of circles
20 0 20 40 60 80 100
PERCENTAGE FREQUENCY SCALE
ARCTIC AREA

FILE STAT 422424-6 | BASE STAT 422086-2 | FIGURE

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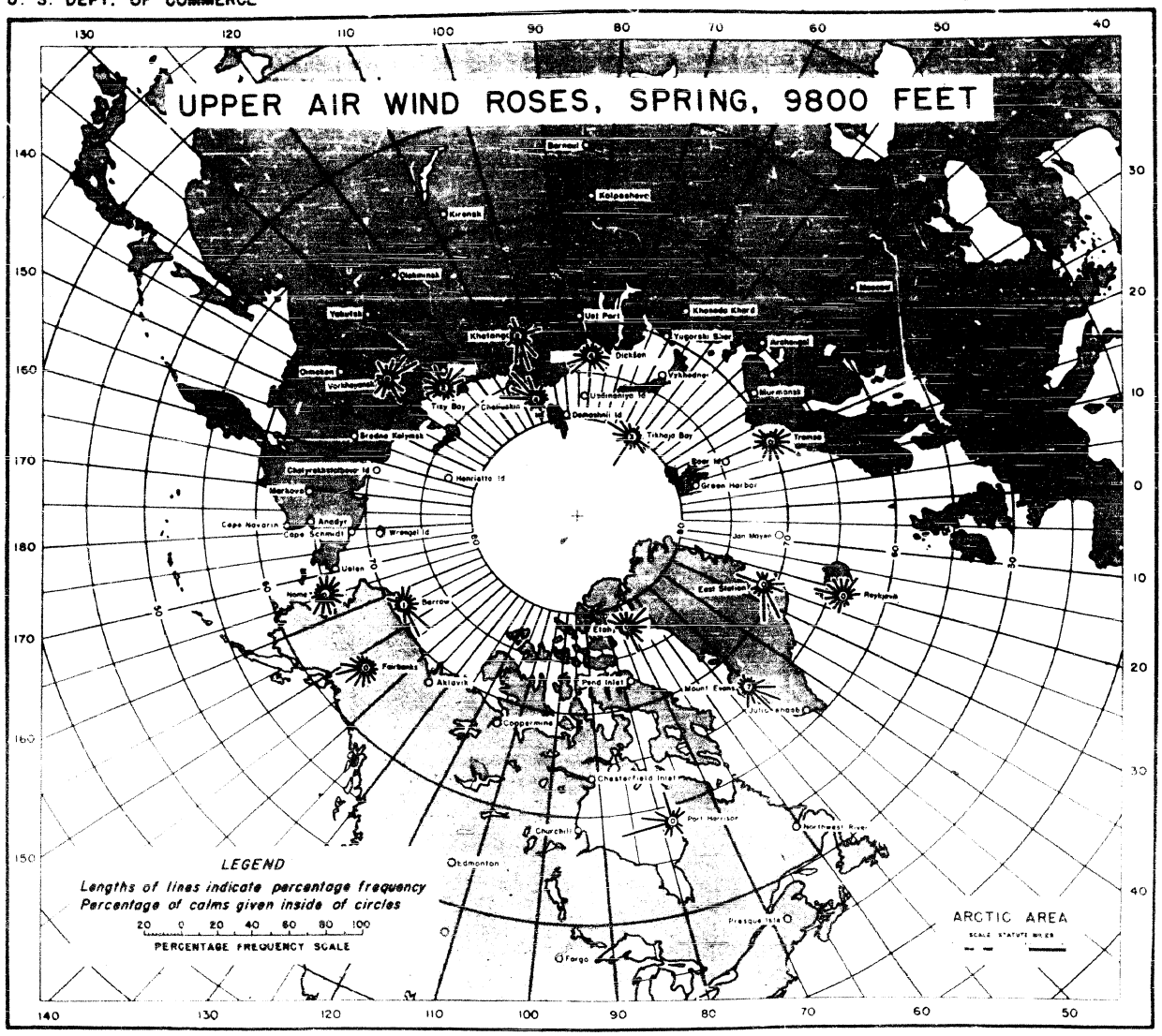

FILE STAT 422424-7 BASE STAT 422086-2 FIGURE

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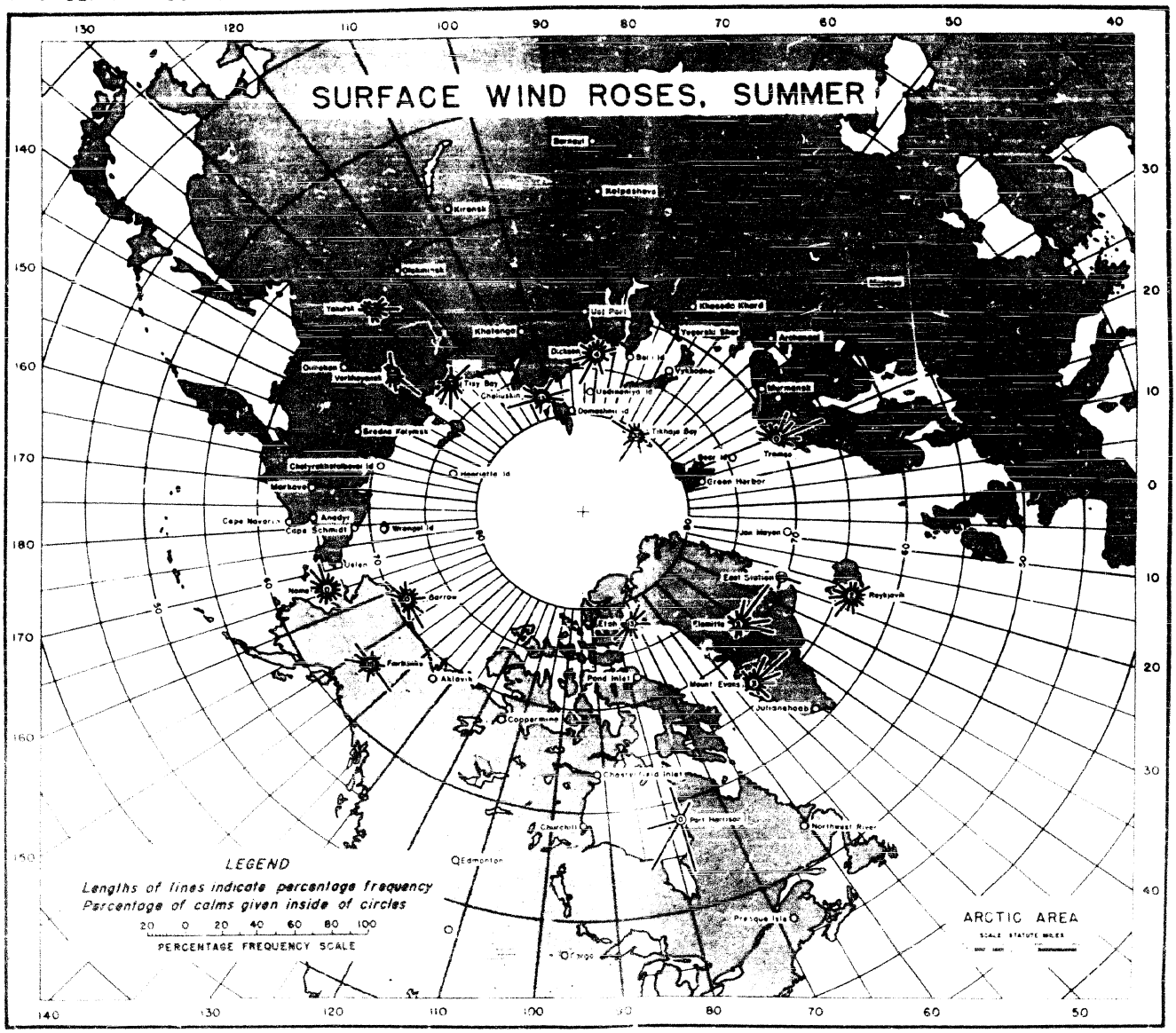

FILE STAT 422424- BASE 422086-2 FIGURE

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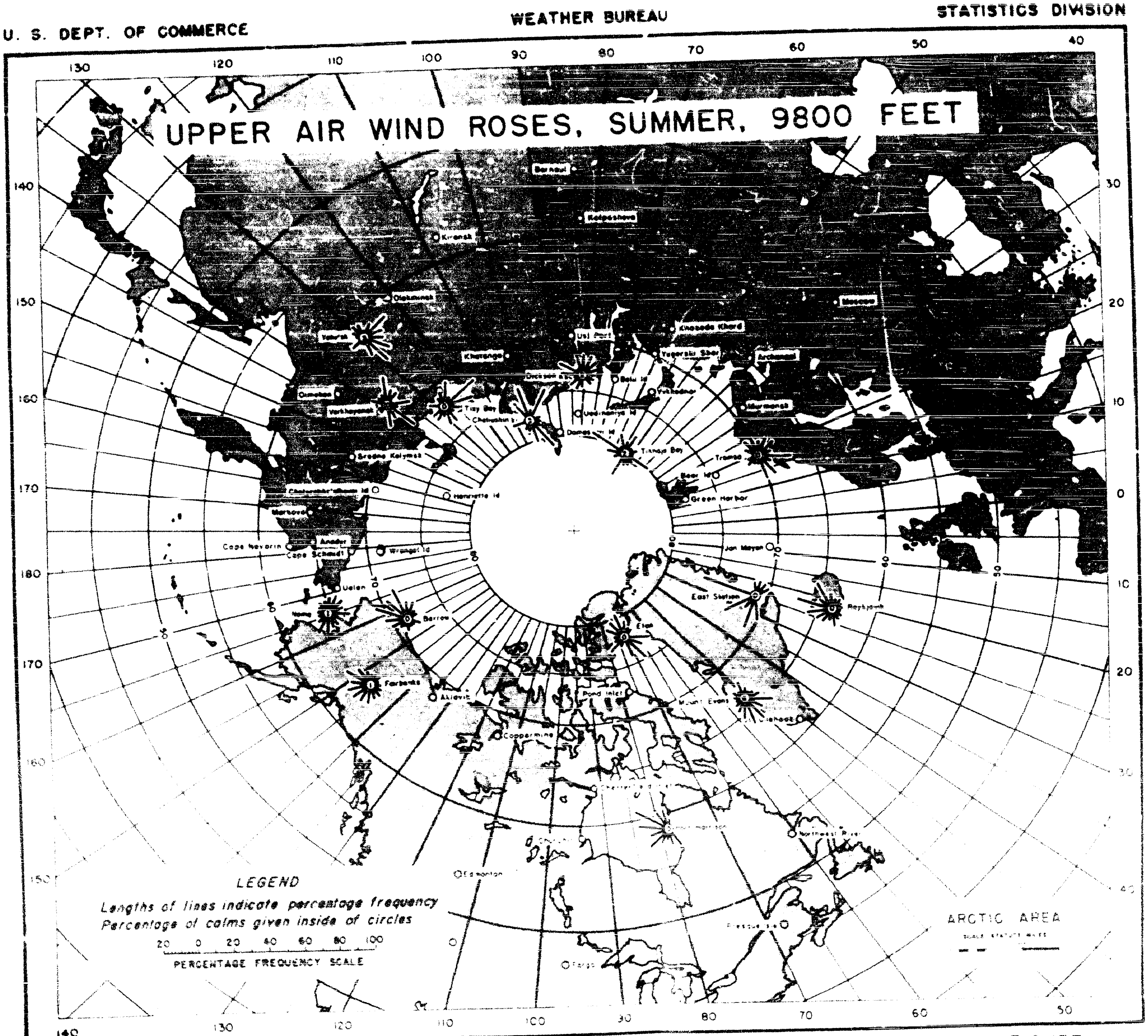

FILE STAT 422424-1

BASE STAT 422086-2

FIGURE

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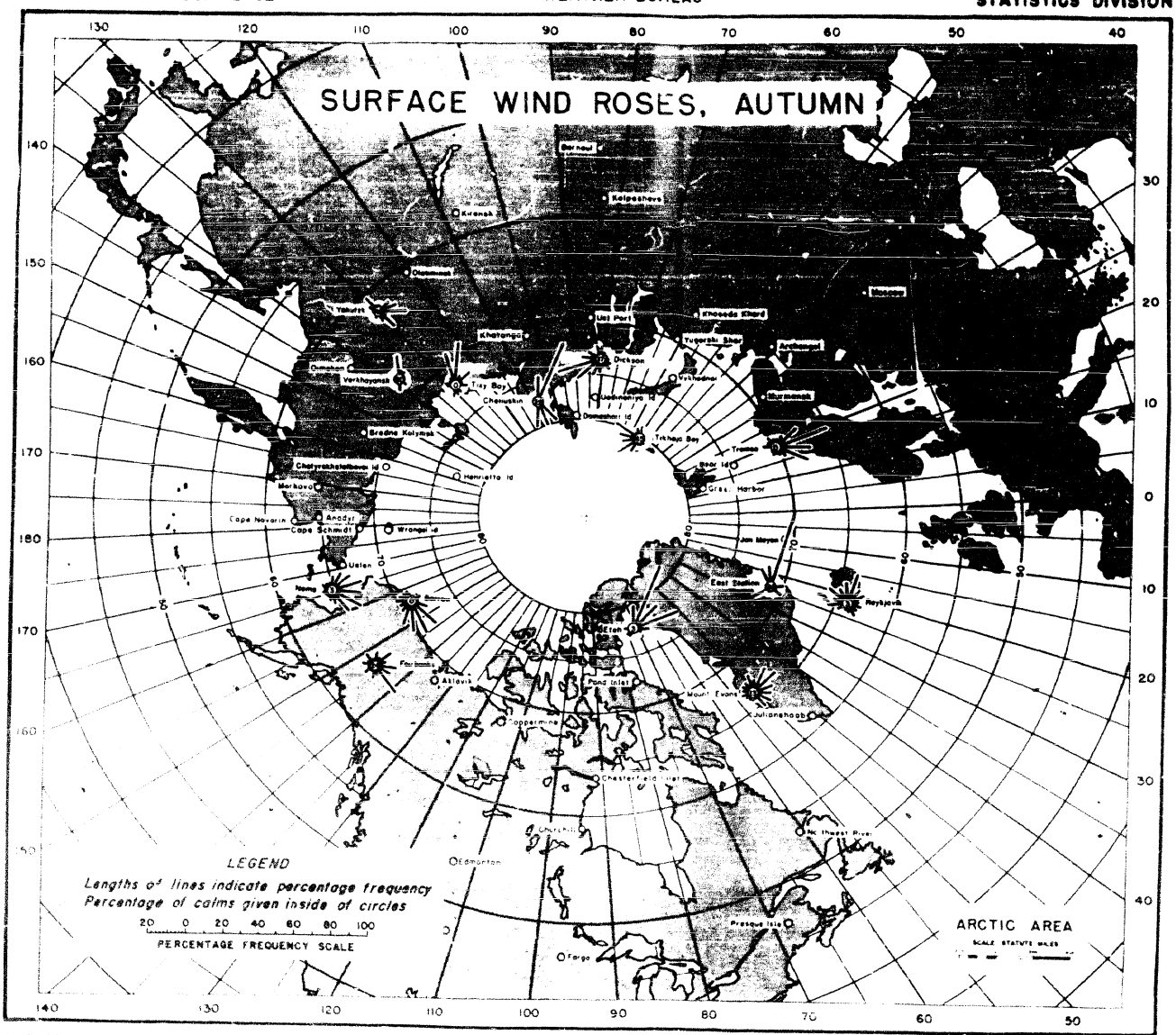

FILE STAT 422424-2 BASE STAT 422086-2 FIGURE

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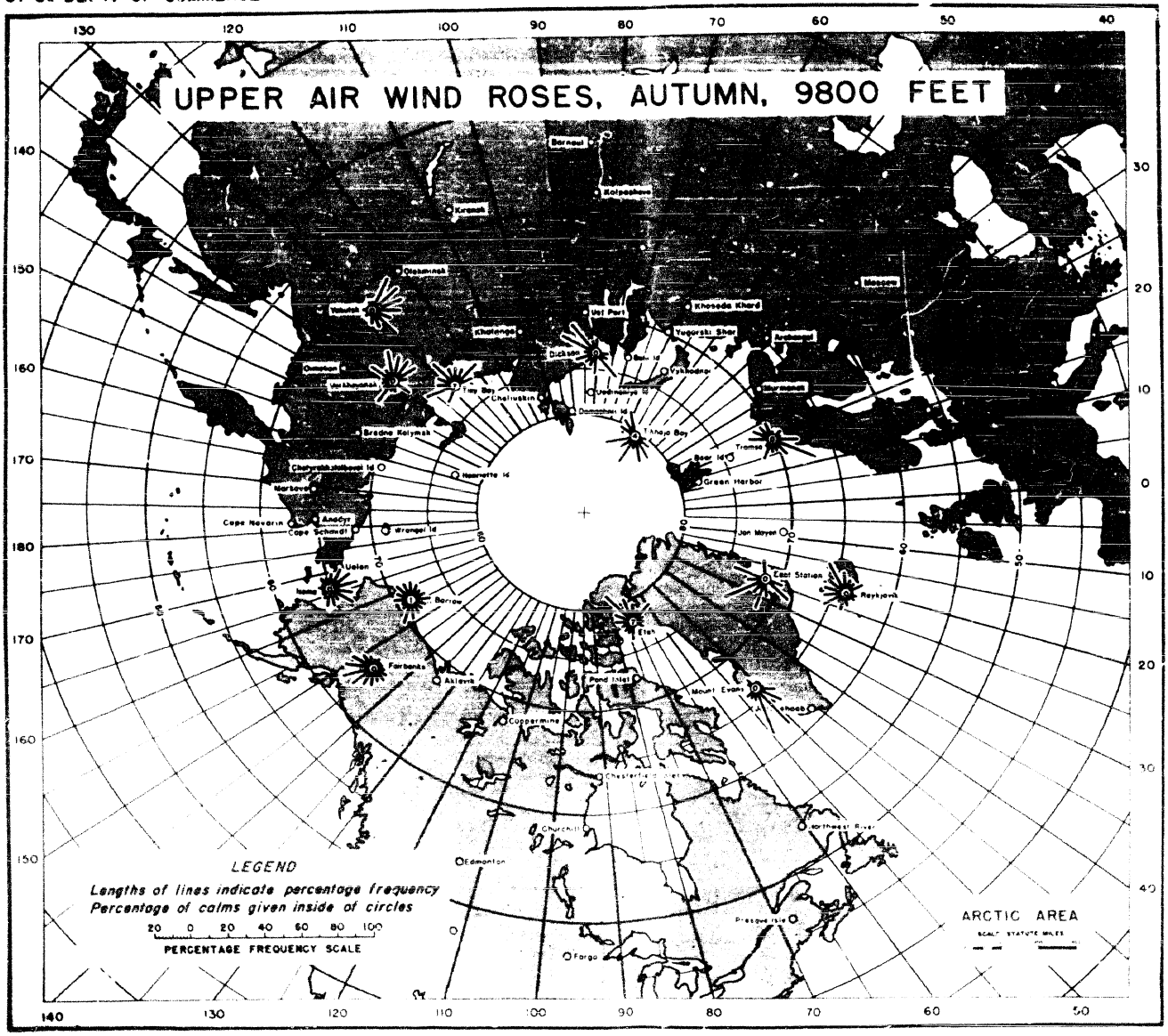

FILE STAT 422424-3 BASE STAT 422086.2 FIGURE

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Climatology of the Arctic Regions - Part III

Part of 65130

(None)

(Not known)
U. S. Army Air Forces, Air Weather Service, Washington, D. C.
(Same)

Part of
Special Study 58

(Same)

Dec '46 Restr. U.S. English 62 tables, graphs, maps

Tables and graphs of climatic data for the entire year and a bibliography of the Arctic regions are presented.

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Meteorology (30)
Climatology (7)

Meteorologic data - Arctic regions (61700)
Meteorology - Research (61815)

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RESTRICTED

SPECIAL STUDY NO. 58

AIR WEATHER SERVICE

CLIMATOLOGY OF THE ARCTIC REGIONS

PART III

DECEMBER 1946

PUBLICATIONS OF HEADQUARTERS, AIR WEATHER SERVICE

RESTRICTED

7-6591, AF

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Table 79

Weather Conditions as Shown on Form 1141-A at:

Barrow, Alaska

(Based on 2989 Obs.)

	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Ann.
Ceiling Height (ft.)													
0-300	0.9	2.3	2.1	3.7	2.9	12.7	13.8	19.8	20.2	8.2	4.6	0.5	7.6
301-600	0.9	4.7	3.1	0.0	4.3	19.1	15.8	17.1	19.7	13.5	10.6	1.9	9.2
601-1000	3.2	8.4	9.8	2.3	16.6	25.6	10.0	17.1	15.0	12.6	18.0	7.7	12.2
1001-2000	23.7	18.6	26.3	8.8	13.8	19.1	7.6	4.1	10.3	20.3	27.6	21.2	16.4
2001-5000	16.2	4.2	10.8	13.4	10.0	4.9	4.8	13.8	11.3	15.5	8.3	19.7	11.1
5001-9750	10.2	9.3	3.6	5.1	2.4	4.0	8.4	5.5	0.9	5.8	3.3	5.3	5.7
Over 9750	44.9	52.5	44.3	66.7	50.0	14.6	39.6	22.6	22.6	24.1	27.6	43.7	37.8
Visibility (mi.)													
0, 1/8	3.2	2.3	0.0	5.5	0.5	2.3	2.6	2.8	4.2	0.9	0.5	0.0	2.1
1/5, 1/4	4.6	0.5	1.0	6.4	1.9	3.5	3.6	6.5	6.0	0.5	0.9	0.5	3.0
1/2	3.2	0.9	7.2	0.9	5.7	1.4	1.4	1.8	5.1	0.5	2.8	1.0	2.6
3/4, 1	2.8	0.9	4.1	5.5	10.0	3.1	1.4	6.9	7.0	3.8	4.1	6.2	4.6
1 1/4 to 2 inc.	7.4	2.3	4.6	5.1	3.3	5.1	3.3	4.6	3.7	1.4	6.0	4.3	4.3
2 1/2 to 6 inc.	12.0	6.9	12.4	15.7	7.1	14.2	7.0	13.5	6.5	4.3	11.1	12.4	10.2
7 to 12 inc.	27.6	27.4	19.6	19.8	19.1	27.7	13.9	22.7	16.3	17.7	29.9	19.5	21.8
13 and over	39.2	53.8	51.1	41.1	52.4	42.7	66.8	41.2	51.2	70.9	44.7	56.1	51.4

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Table 80

Weather Conditions as Shown on Form 1141 A at:

Council, Alaska

(Approximately 2 to 6 Observations per day)

(Based on 5671 Obs)

	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Ann.
General Conditions													
Lt. & Mod. Fog	2.6	3.2	3.5	4.7	2.1	3.4	2.0	8.1	3.2	4.9	5.2	3.4	3.9
Dense Fog	0.5	0.0	0.2	0.5	0.0	0.8	0.0	0.0	0.2	0.2	0.9	0.0	0.3
Thick Haze, Smoke, Dust	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip.	13.9	6.5	13.4	16.6	17.8	15.2	3.6	24.4	20.2	25.9	13.6	16.7	15.7
Thunder-storms	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0
Ceiling Height (ft.)													
0-300	1.9	1.4	1.6	2.3	1.7	1.1	0.3	2.6	3.6	2.0	4.2	4.1	2.2
301-600	1.5	0.8	1.4	2.7	3.9	2.3	1.0	3.9	3.6	5.0	2.2	4.3	2.6
601-1000	5.5	3.8	7.1	6.7	6.6	4.2	1.3	7.1	8.4	7.6	4.2	6.3	5.7
1001-2000	7.3	4.0	5.8	5.9	7.7	3.4	0.7	7.5	10.2	8.9	5.4	5.4	6.0
2001-5000	14.4	7.9	12.2	9.5	11.7	11.0	8.6	27.6	26.9	19.0	15.4	13.6	14.7
5001-9750	13.9	4.7	7.8	11.9	12.0	17.7	5.6	18.8	10.0	11.4	10.8	10.9	11.3
Over 9750	55.5	77.5	64.1	61.0	57.4	60.3	82.4	72.5	37.3	47.0	57.9	55.4	57.4
Visibility (mi.)													
0, 1/8	0.8	0.6	0.5	0.5	1.3	0.8	0.3	1.3	1.8	0.7	0.5	2.0	0.9
1/5, 1/4	1.3	1.0	1.4	0.4	2.4	1.1	0.0	0.0	0.0	0.0	1.6	1.8	0.9
1/2	1.9	2.2	0.5	2.5	1.9	0.6	0.0	0.3	0.8	0.4	1.1	2.3	1.2
3/4, 1	2.6	3.2	4.6	4.2	4.1	1.1	0.0	0.8	1.4	1.8	2.2	2.0	2.3
1 1/4, to 2 inc.	2.0	1.3	3.9	5.2	3.9	3.9	1.7	2.6	3.2	4.5	2.9	2.3	3.2
2 1/2 to 5 inc.	3.0	4.3	4.8	3.0	3.4	4.5	2.3	0.8	3.0	3.3	3.8	5.4	6.0
7 to 12 inc.	9.1	5.7	4.6	4.1	3.7	2.3	1.7	4.2	5.6	6.7	2.9	5.2	4.7
13 and over	75.7	81.8	78.7	75.9	74.7	85.6	93.1	88.1	79.2	77.6	83.0	79.0	80.8

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Table 81

Weather Conditions as Shown on Form 1141-A at

Fairbenks, Alaska

	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug			
General Conditions												
Lt. & Mod. Fog	6.4	4.8	4.9	2.2	0.0	0.0	0.4	1.1				
Dense Fog	0.3	1.3	2.2	0.2	0.0	0.0	0.0	0.0				
Thick Haze, Smoke, Dust	2.3	0.6	1.1	0.0	0.0	0.0	0.0					
Precip.	16.2	14.6	7.8	4.7	6.5	7.3	8.1	8.4	11.0			
Thunder-storms	0.0	0.0	0.0		0.0	0.1	0.1					
Ceiling Height (ft.)												
0-300	0.6	1.4	1.7	0.3		0.1	0.3	0.1				
301-600	2.7	2.5	1.5	1.4	0.3	0.5	1.3					
601-1000	3.0	3.9	2.5	3.3	2.6	0.1	1.5	2.4				
1001-2000	5.6	5.7	2.7	4.0	2.7	3.4	2.5	6.7				
2001-5000	10.8	11.7	6.1	13.7	12.2	21.4	25.0	25.5	21.7			
5001-9750	14.2	10.9	12.3	13.1	12.1	16.8	11.1	10.0				
Over 9750	63.1	63.8	73.1	64.1	69.9	57.6	58.3	54.6	49.4			
Visibility (mi.)												
0, 1/8	0.5	1.3	1.1	0.1	0.0	0.0	0.0	0.0				
1/5, 1/4	0.6	0.1	1.0	0.4	0.0	0.0	0.0	0.0				
1/2	1.9	1.4	2.4	0.3	0.6	0.0	0.3					
3/4, 1	2.8	3.3	1.9	0.4	1.1	0.1						
1 1/4 to 2 inc.	3.6		1.9		1.1							
2 1/2 to 6 inc.	7.7		3.9	4.7	1.2							
7 to 12 inc.	9.8			4.1								
13 and over		76.1	84.1		94.		9					

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Table 82

Weather Conditions as Shown on Form 1141-A at:

Fargo, North Dakota

(Based on 66776 Obs.)

	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Ann.
General Conditions													
Lt. & Mod. Fog	13.5	16.3	12.2	4.1	6.4	2.4	2.3	2.3	2.2	3.4	3.3	5.6	6.2
Dense Fog	1.7	0.4	1.1	0.6	0.6	+	0.0	0.2	0.3	0.6	0.6	0.9	0.6
Thick Haze, Smoke, Dust	0.1	0.4	0.0	0.4	0.3	0.6	0.0	+	0.0	0.3	0.3	0.5	0.3
Precip.	15.5	19.1	13.6	8.7	11.9	8.3	5.2	3.7	3.4	4.2	5.4	11.6	9.2
Thunder-Storms	0.0	0.0	0.0	0.0	0.3	0.8	1.5	1.1	1.6	0.6	0.1	0.0	0.0
Ceiling Height (ft.)													
0-300	6.4	3.4	5.1	1.6	2.3	0.5	0.3	0.5	0.3	1.2	1.2	3.8	2.3
301-600	5.3	4.1	3.7	3.1	4.4	2.6	0.8	0.7	0.9	1.0	1.9	4.2	2.8
601-1000	8.7	9.0	7.2	6.7	7.3	4.7	2.4	0.9	1.7	2.8	4.3	6.5	5.2
1001-2000	10.1	10.7	7.3	9.0	9.0	7.1	4.5	2.9	2.9	4.9	8.0	10.7	7.3
2001-5000	11.6	10.6	8.7	14.0	14.0	16.5	13.5	8.7	8.5	9.1	11.6	14.9	11.8
5001-9750	5.4	4.5	4.2	5.2	5.5	6.6	6.6	5.6	5.6	6.5	6.2	5.0	5.6
Over 9750	52.4	57.7	63.8	60.5	57.6	62.0	72.0	80.7	80.0	74.5	66.8	55.0	65.3
Visibility (mi.)													
0, 1/8	2.0	1.6	2.7	0.7	0.5	+	0.0	0.1	0.2	0.5	0.5	1.2	0.8
1/5, 1/4	1.4	1.9	2.1	1.3	0.5	0.3	0.1	0.1	0.1	0.2	0.2	1.4	0.8
1/2	2.0	2.8	2.0	0.8	0.8	0.4	0.2	0.2	0.1	0.5	0.3	1.5	1.0
3/4, 1	4.5	5.6	4.3	2.4	2.0	0.8	0.3	0.2	0.3	1.1	1.5	3.2	2.2
1 1/4 to 2 inc.	6.0	7.3	6.6	3.6	2.4	1.5	0.7	0.4	1.2	1.6	1.9	3.4	3.1
2 1/2 to 6 inc.	17.7	25.3	23.9	15.6	14.9	9.4	6.8	4.5	9.1	10.8	12.7	11.3	13.5
7 to 12 inc.	58.4	48.0	51.3	68.4	69.7	76.0	78.3	80.7	73.9	69.8	72.2	67.9	67.7
13 and over	8.0	7.4	7.1	9.3	9.2	11.6	13.7	13.8	15.2	15.6	19.8	10.1	11.0

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Table 8

Weather Conditions as Shown on Form 1141-A at:

Gambell, Alaska

(Approximately 1 to 2 Observations per day)

(Based on 538 Obs.)

---	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Ann.
General Conditions													
Lt. & Mod. Fog	1.3	4.2	6.8	2.2	4.3	13.8	40.0	0.0	9.7	3.8	10.0	0.0	
Dense Fog	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.2	3.8	0.0	0.0	
Thick Haze, Smoke, Dust	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Precip.	16.7	7.0	8.0	9.8	13.0	3.4	0.0	0.0	6.5	30.8	33.3	24.6	
Thunder-storms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Ceiling Height (ft.)													
0-300	6.4	9.9	5.7	9.8	0.0	3.4	0.0	0.0	6.5	3.8	3.3	9.2	
301-500	14.1	7.0	6.8	4.3	0.0	10.3	0.0	0.0	12.9	19.2	23.3	9.2	
601-1000	12.8	7.0	10.2	7.6	4.3	6.9	20.0	0.0	22.6	7.7	26.7	15.4	
1001-2000	14.1	9.9	10.2	15.2	21.7	6.9	0.0	0.0	9.7	34.6	10.0	23.1	
2001-5000	12.8	14.1	5.7	8.7	39.1	51.7	0.0	0.0	29.0	23.1	16.7	16.9	
5001-9750	1.3	2.8	3.4	2.2	0.0	3.4	0.0	0.0	0.0	0.0	0.0	0.0	
Over 9750	38.5	49.3	57.9	52.2	34.8	17.2	80.0	0.0	19.3	11.5	20.0	26.1	
Visibility (mi.)													
0, 1/8	3.8	7.0	3.4	2.2	0.0	0.0	0.0	0.0	3.2	3.8	0.0	4.6	
1/5, 1/4	0.0	1.4	1.1	3.3	0.0	3.4	0.0	0.0	0.0	0.0	0.0	0.0	
1/2	2.6	2.8	5.7	3.4	0.0	0.0	0.0	0.0	0.0	0.0	3.3	4.6	
3/4, 1	16.7	7.0	6.8	5.4	13.0	10.3	20.0	0.0	3.2	19.2	20.0	13.8	
1 1/4 to 2 inc.	6.4	4.2	5.7	5.4	8.6	13.8	0.0	0.0	6.5	7.7	10.0	6.2	
2 1/2 to 6 inc.	19.2	19.7	15.9	26.1	43.5	48.3	20.0	10.0	16.1	19.2	20.0	24.6	
7 to 12 inc.	3.8	7.0	0.0	4.3	0.0	13.8	0.0	0.0	32.3	34.6	13.3	9.2	
13 and over	47.4	50.7	61.3	47.8	34.8	10.3	60.0	0.0	38.7	15.4	33.3	36.9	

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Table 84

Weather Conditions as Shown on Form 1141-A at:

Great Falls, Montana

(Based on 6,881 Obs.)

	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Ann.
General Conditions													
Lt. & Mod. Fog	6.0	0.9	16.1	9.6	2.5	6.5	10.9	0.3	0.3	0.2	4.3	4.5	5.2
Dense Fog	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	3.1	0.4	0.3
Thick Haze, Smoke, Dust	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	+
Precip.	5.8	1.9	11.0	13.5	7.6	14.3	9.5	2.1	4.9	2.2	9.0	8.1	7.5
Thunder-storms	0.0	0.0	0.0	0.0	0.0	1.3	1.7	0.9	0.7	0.2	0.0	0.0	0.4
Ceiling Height (ft.)													
0-300	0.9	0.9	2.1	7.5	1.6	4.0	2.9	0.0	0.0	0.0	6.7	2.1	2.4
301-600	1.2	0.0	8.3	4.3	1.7	5.1	0.7	0.0	0.0	0.1	2.2	3.1	2.2
601-1000	1.1	1.7	5.8	2.6	4.1	3.6	5.7	0.4	0.1	0.4	1.6	1.5	2.4
1001-2000	4.5	0.0	4.9	4.5	4.5	5.7	5.4	2.7	2.0	1.7	4.2	4.6	3.7
2001-5000	9.5	9.2	4.3	6.6	18.6	25.3	16.1	8.0	8.1	5.8	7.2	14.1	11.1
5001-9750	13.1	12.8	9.1	13.0	10.0	6.1	8.2	5.3	13.0	6.9	6.4	15.7	10.0
Over 9750	69.7	75.4	65.4	61.5	59.6	50.2	60.9	83.6	76.8	85.1	71.7	59.0	68.3
Visibility (mi.)													
0, 1/8	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6	0.4	0.5
1/5, 1/4	0.0	0.0	0.0	0.0	0.7	0.2	0.3	0.0	0.0	0.0	0.9	1.3	0.3
1/2	0.2	0.0	1.4	2.4	1.2	0.0	0.6	0.0	0.0	0.1	0.4	1.0	0.6
3/4, 1	1.6	0.0	2.8	4.6	0.0	0.4	1.9	0.0	0.0	0.0	0.6	1.6	1.1
1 1/4 to 2 inc.	1.4	0.9	3.8	2.3	1.3	0.0	4.2	0.0	0.0	0.0	1.7	0.6	1.4
2 1/2 to 6 inc.	5.5	0.8	16.6	4.7	7.7	10.3	9.3	1.9	0.3	0.8	2.9	3.3	5.3
7 to 12 inc.	3.0	3.6	17.3	20.7	22.1	22.4	16.9	20.9	8.0	1.3	14.7	4.2	12.9
13 and over	88.2	94.6	58.0	62.7	67.0	66.8	66.8	77.2	91.7	97.7	76.2	87.6	77.9

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Table 35

Weather Conditions as Shown on Form 1141-A at:

Hot Springs, Alaska

(Based on 6613 Obs.)

	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Ann
General Conditions													
Lt. & Mod. Fog	11.8	8.1	4.5	1.1	0.7	0.8	2.8	4.3	13.7	6.2	7.1	3.9	5.4
Dense Fog	2.6	1.8	2.5	0.0	0.0	0.2	0.2	0.0	0.0	0.6	0.0	0.2	0.7
Thick Haze, Smoke, Dust	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.4	0.2	0.2	0.3	0.2	0.2
Precip.	9.9	14.1	9.4	10.2	7.2	8.0	11.0	18.6	27.1	18.7	17.2	14.1	13.8
Thunder-storms	0.0	0.0	0.0	0.2	0.2	1.0	2.8	0.2	0.0	1.0	0.2	0.2	0.5
Ceiling Height (ft.)													
0-300	5.8	1.1	3.0	2.9	1.5	2.0	1.6	0.2	2.8	2.6	3.9	7.4	2.9
301-600	2.9	3.2	1.8	1.2	0.9	0.6	0.8	1.6	5.2	2.2	3.7	3.5	2.3
601-1000	5.1	4.4	4.4	2.9	2.2	1.8	1.8	5.2	6.8	4.2	5.2	5.8	4.0
1001-2000	8.2	6.5	8.4	6.3	3.7	3.2	8.7	8.1	14.9	10.5	12.1	9.0	8.3
2001-5000	18.9	17.0	16.3	15.3	18.0	19.8	19.9	22.3	21.5	26.6	21.1	25.2	20.2
5001-9750	2.2	2.3	3.0	5.9	2.8	6.8	4.9	7.0	8.4	6.4	3.2	2.3	4.6
Over 9750	56.8	65.5	63.0	65.4	70.9	65.9	62.3	55.6	40.4	47.5	52.7	46.8	57.8
Visibility (mi.)													
0, 1/8	6.1	0.0	4.7	2.6	1.3	2.0	1.6	0.0	2.0	2.0	3.9	7.0	2.8
1/5, 1/4	0.2	0.7	0.3	0.0	0.2	0.0	0.0	0.0	0.0	0.2	0.0	0.5	0.2
1/2	2.2	1.9	1.5	0.5	0.4	0.0	0.0	0.6	0.4	0.2	2.0	2.6	1.0
3/4, 1	2.4	0.9	1.7	0.9	0.4	0.0	0.4	0.4	1.4	0.6	2.0	1.4	1.0
1 1/4 to 2 inc.	2.4	2.7	1.2	1.7	0.7	0.6	0.4	0.8	3.6	0.6	2.0	2.3	1.6
2 1/2 to 6 inc.	8.7	7.4	5.1	5.7	4.8	4.2	6.3	8.3	12.5	9.5	12.4	8.3	7.8
7 to 12 inc.	10.4	8.0	8.2	4.9	3.9	5.4	10.7	10.7	11.2	10.0	9.9	8.6	8.5
13 and over	67.6	78.4	76.0	87.6	88.3	87.8	80.7	79.3	68.9	76.9	67.9	69.0	77.1

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Table 86

Weather Conditions as Shown on Form 1141-A at:

Nenana, Alaska

(Approximately 2 Observations per day)

(Based on 7079 Obs.)

	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Ann.
General Conditions													
Lt. & Mod. Fog	1.4	1.1	3.4	1.1	0.3	0.0	0.0	0.0	1.3	0.3	1.3	1.7	1.0
Dense Fog	1.3	0.0	0.5	0.2	0.0	0.0	0.0	0.0	0.2	0.7	0.7	0.3	0.4
Thick Haze, Smoke, Dust	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip.	3.8	5.7	5.4	4.3	3.0	3.0	3.6	4.7	9.4	6.8	7.9	5.7	5.3
Thunder-storms	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	+
Ceiling Height (ft.)													
0-300	2.4	1.7	3.4	0.8	0.6	0.4	0.2	0.3	1.1	2.2	1.6	2.3	1.4
301-600	1.6	1.1	3.2	1.2	0.6	0.0	0.2	0.5	0.6	1.5	4.3	2.5	1.6
601-1000	11.9	14.0	11.2	6.5	7.3	4.0	1.2	4.3	9.7	8.3	11.9	14.2	9.1
1001-2000	10.7	13.7	9.7	10.9	10.4	9.3	9.7	15.6	23.2	26.6	16.7	14.8	14.3
2001-5000	16.1	9.9	15.6	10.0	15.3	21.0	29.4	27.4	25.5	19.9	28.6	18.3	19.1
5001-9750	1.6	4.3	1.7	3.7	2.6	2.5	0.4	0.7	0.3	0.7	1.0	0.5	1.7
Over 9750	55.8	55.3	55.1	62.9	63.1	68.6	58.9	51.1	39.6	40.9	41.9	47.3	52.9
Visibility (mi.)													
0, 1/8	2.5	1.3	2.7	0.8	0.3	0.2	0.0	0.2	0.0	1.0	2.1	2.0	1.1
1/5, 1/4	0.3	0.2	0.7	0.5	0.5	0.0	0.0	0.0	0.3	1.0	0.2	0.2	0.3
1/2	0.6	0.3	0.9	0.8	0.6	0.0	0.0	0.5	1.0	0.5	0.9	0.5	0.6
3/4, 1	0.8	2.4	2.2	0.9	0.8	0.0	0.0	0.9	1.3	0.8	2.1	2.7	1.3
1 1/4 to 2 inc.	1.9	1.3	1.7	0.5	0.5	0.8	0.0	0.5	2.0	0.7	0.9	1.7	1.0
2 1/2 to 6 inc.	2.2	3.3	2.7	2.6	1.4	1.5	4.4	2.3	5.7	6.0	5.9	5.8	3.6
7 to 12 inc.	3.5	0.9	2.7	1.3	0.8	0.0	1.4	3.5	4.4	3.5	3.1	2.7	2.4
13 and over	88.2	90.3	86.4	92.5	95.0	97.5	94.2	92.2	85.3	86.6	84.8	84.4	89.4

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Table 87

Weather Conditions as Shown on Form 1141-A at:

Nome, Alaska

(Based on 12192 Obs.)

	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Ann.
General Conditions													
Lt. & Mod. Fog	4.1	0.4	4.1	10.1	6.4	4.3	9.0	7.2	3.0	4.3	3.3	7.1	5.3
Dense Fog	0.0	0.6	0.5	1.8	0.8	0.9	1.4	0.2	0.3	0.0	0.2	0.6	0.6
Thick Haze, Smoke, Dust	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip.	24.2	18.5	20.3	42.7	34.9	19.0	8.0	28.4	18.1	18.8	16.5	21.3	22.6
Thunder-storms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ceiling Height (ft.)													
0-300	1.0	1.1	5.3	3.9	4.4	4.8	5.7	3.9	2.9	2.2	2.6	5.6	3.7
301-600	2.8	1.0	5.3	3.9	7.2	5.6	5.1	11.6	7.7	6.7	4.3	7.9	5.8
601-1000	7.1	6.6	6.6	7.5	9.9	5.7	5.7	18.8	13.4	14.4	7.4	7.2	9.2
1001-2000	12.1	6.4	7.7	7.8	14.5	8.5	5.6	17.3	22.7	14.1	14.4	11.7	11.9
2001-5000	15.2	11.2	8.6	12.3	20.2	11.8	8.6	18.6	19.7	21.0	15.0	13.6	14.7
5001-9750	13.0	8.6	8.7	8.3	11.0	8.8	8.7	10.4	8.5	12.9	8.0	6.3	9.5
Over 9750	48.0	65.1	57.6	55.3	32.8	54.7	60.7	19.5	25.0	28.8	48.3	47.7	45.3
Visibility (mi.)													
0, 1/8	0.0	0.5	2.5	0.9	0.8	0.1	0.4	0.0	0.2	0.0	0.0	0.5	0.5
1/5, 1/4	0.2	0.3	0.7	1.6	1.0	1.2	1.3	0.2	0.3	0.0	0.2	1.3	0.7
1/2	1.7	1.1	2.9	2.4	5.1	1.3	0.9	1.0	0.8	0.4	1.8	4.1	2.0
3/4, 1	0.9	1.4	4.6	3.3	3.2	2.0	0.3	1.5	1.4	1.2	1.6	2.7	2.0
1 1/4 to 2 inc.	2.4	2.0	2.5	3.8	3.6	2.0	0.8	4.1	3.1	2.6	2.3	4.0	2.8
2 1/2 to 6 inc.	12.0	7.2	6.2	7.5	9.7	4.4	8.7	13.8	5.5	10.1	7.2	8.0	8.4
7 to 12 inc.	14.0	10.1	7.3	7.0	13.2	7.0	6.9	17.3	11.7	10.3	7.4	6.5	9.9
13 and over	68.2	77.2	73.3	72.6	63.6	81.8	80.6	62.1	76.8	75.5	79.5	73.0	73.7

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Table 88

Weather Conditions as Shown on Form 1141-A at:

Nulato, Alaska

(Approximately 2 to 13 Observations per day)

(Based on 5623 Obs.)

	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Ann.
General Conditions													
Lt. & Mod. Fog	3.2	2.5	5.6	3.0	0.6	1.3	0.4	1.5	3.9	3.0	1.5	7.4	2.8
Dense Fog	2.0	4.0	2.0	2.0	0.1	0.6	0.8	3.2	9.0	6.7	4.6	4.0	3.2
Thick Haze, Smoke, Dust	1.0	0.3	0.2	0.3	0.4	1.9	4.7	2.4	1.2	0.7	0.5	1.1	1.3
Precip.	13.9	17.5	19.9	13.0	11.5	12.8	4.7	17.1	21.4	16.7	15.7	16.7	15.1
Thunder-storms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ceiling Height (ft.)													
0-300	4.6	6.0	13.2	2.9	2.9	1.9	0.0	2.2	7.5	9.3	8.2	9.8	5.7
301-600	2.9	6.3	3.4	4.2	4.0	0.6	1.7	3.7	7.8	6.3	6.4	6.6	4.5
601-1000	9.0	9.3	6.3	4.7	2.8	3.1	2.1	6.3	12.6	7.4	10.3	8.5	6.9
1001-2000	16.9	7.0	8.0	7.6	5.0	5.9	2.1	8.3	8.0	10.2	7.7	10.8	8.1
2001-5000	17.8	14.5	20.4	23.6	21.6	20.9	15.3	26.3	23.3	27.4	26.0	17.5	21.2
5001-9750	2.0	1.3	1.6	1.8	3.8	15.9	23.3	10.5	7.5	5.8	6.8	4.0	7.1
Over 9750	46.7	55.6	47.2	55.3	59.0	56.6	55.5	42.7	33.3	33.5	35.2	42.9	46.6
Visibility (mi.)													
0, 1/8	2.0	3.0	1.4	1.6	1.4	1.9	0.0	1.9	5.8	8.4	5.4	4.5	3.0
1/5, 1/4	0.2	1.5	3.4	1.0	0.4	0.0	0.0	0.0	0.7	0.2	1.0	1.1	0.8
1/2	2.2	3.3	6.0	1.6	1.6	0.6	0.6	1.2	2.2	2.1	2.6	3.7	2.3
3/4, 1	2.4	3.0	3.8	2.1	2.0	0.6	0.8	2.2	3.3	2.1	4.9	5.0	2.7
1 1/4 to 2 inc.	3.6	3.8	2.2	1.6	1.8	0.6	0.4	2.1	3.5	2.6	2.6	4.2	2.4
2 1/2 to 6 inc.	9.5	6.0	6.3	6.0	3.0	1.3	0.4	4.6	8.7	7.2	6.2	6.6	5.5
7 to 12 inc.	10.7	9.5	8.3	5.1	4.3	2.5	2.5	8.8	8.5	8.0	8.0	7.1	6.6
13 and over	69.6	72.6	68.6	81.1	86.1	92.5	95.8	79.5	67.2	71.4	69.4	67.7	76.7

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Table 89

Weather Conditions as Shown on Form 1141-A at:

Pilgrim Springs, Alaska

(Approximately 2 to 5 Observations per day)

(Based on 2207 Obs.)

	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Ann.
General Conditions													
Lt. & Mod. Fog	9.3	7.5	1.9	10.8	4.1	7.0	2.0	1.8	5.2	7.3	4.3	7.1	5.7
Dense Fog	7.1	8.4	3.8	3.9	1.3	2.9	1.3	3.5	8.0	6.1	6.1	5.9	4.9
Thick Haze, Smoke, Dust	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip.	15.7	5.6	8.2	16.2	8.2	9.3	3.3	11.8	17.2	18.8	19.6	15.9	12.5
Thunder-storms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ceiling Height (ft.)													
0-300	19.3	12.1	13.5	16.7	8.5	7.6	2.0	7.6	14.4	9.1	17.4	17.6	12.2
301-600	2.0	4.7	8.7	3.4	1.9	3.5	1.3	2.9	2.3	2.4	3.0	4.7	3.4
601-1000	10.0	4.7	3.4	2.5	3.5	4.7	1.3	4.1	4.6	4.2	10.4	6.5	4.9
1001-2000	7.1	5.6	4.8	9.8	15.5	15.1	6.0	8.8	14.4	9.7	11.7	7.1	9.7
2001-5000	12.9	12.1	14.9	16.7	23.3	29.1	18.0	48.2	39.1	49.1	31.3	11.2	25.5
5001-9750	2.9	0.9	6.3	7.8	9.1	8.1	15.3	10.6	5.7	6.7	2.6	0.0	6.3
Over 9750	45.0	59.8	48.6	43.1	38.2	32.0	56.0	17.6	19.3	18.8	23.5	52.9	38.0
Visibility (mi.)													
0, 1/8	7.1	8.4	8.7	9.8	4.4	4.7	1.3	5.9	11.5	7.9	15.2	10.6	8.0
1/5, 1/4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.1
1/2	2.1	0.0	4.3	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0	3.5	0.9
3/4, 1	2.1	1.9	0.0	3.4	1.6	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.9
1 1/4 to 2 ininc.	4.3	0.9	5.8	3.9	3.8	1.2	0.0	1.2	1.7	0.6	0.9	0.6	2.1
2 1/2 to 6 inc.	18.6	10.3	11.1	17.2	19.6	8.7	2.0	12.4	12.6	13.9	10.9	14.1	12.6
7 to 12 inc.	12.9	9.3	29.3	8.8	9.1	22.1	7.3	16.5	21.8	18.2	20.9	14.7	15.9
13 and over	57.9	69.2	40.9	56.9	61.5	62.2	89.3	64.1	51.1	59.4	52.2	55.9	59.6

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Table 90

Weather Conditions as Shown on Form 1141-A at:

Ruby, Alaska

(Based on 11280 Obs.)

	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Ann.
General Conditions													
Lt. & Mod. Fog	8.2	7.5	6.8	9.2	2.5	2.0	1.8	8.3	6.8	10.1	5.7	11.7	6.7
Dense Fog	0.7	0.7	2.8	1.2	1.0	0.5	0.1	0.1	1.4	2.6	1.4	0.9	1.1
Thick Haze, Smoke, Dust	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.1
Precip.	11.0	9.8	10.8	10.1	7.1	6.6	4.0	12.1	11.8	16.5	12.3	18.8	10.9
Thunder-storms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.7	0.0	0.0	0.0	0.1
Ceiling Height (ft.)													
0-300	0.5	3.9	0.8	3.0	0.8	1.2	0.4	0.4	2.4	3.2	3.0	2.0	1.8
301-600	4.2	4.6	1.7	1.0	1.1	1.1	0.7	2.0	3.8	6.3	2.6	5.1	2.9
601-1000	8.0	4.1	4.1	2.3	3.7	2.3	1.9	5.2	5.4	9.0	5.2	10.4	5.2
1001-2000	10.1	6.8	11.4	3.9	4.1	6.7	7.1	13.2	10.3	12.4	11.8	13.5	9.3
2001-5000	15.0	12.0	23.0	13.8	14.6	26.6	22.5	35.4	28.0	30.0	31.6	18.1	22.6
5001-9750	9.0	5.8	7.2	11.8	15.0	12.7	20.4	13.5	16.0	10.5	14.3	7.6	12.0
Over 9750	53.1	62.8	51.8	64.1	60.8	49.4	46.9	30.4	34.0	28.6	31.5	43.4	46.4
Visibility (mi.)													
0, 1/8	0.3	1.6	1.5	0.7	0.7	0.5	0.4	0.3	1.9	2.4	0.7	1.2	1.1
1/5, 1/4	0.9	1.5	2.6	0.9	0.3	0.0	0.0	0.1	0.0	0.8	0.9	0.4	0.7
1/2	1.1	2.0	2.0	1.3	1.1	0.3	2.4	0.8	1.3	2.3	1.9	5.1	1.8
3/4, 1	2.2	2.8	2.7	3.1	0.8	1.2	0.7	3.0	2.6	4.0	3.6	3.5	2.5
1 1/4 to 2 inc.	2.1	2.8	2.7	2.3	0.6	1.2	1.5	4.2	3.8	1.3	2.2	4.0	2.4
2 1/2 to 6 inc.	6.3	5.7	3.6	3.8	2.1	2.1	5.5	9.4	7.0	5.5	4.3	5.7	5.1
7 to 12 inc.	6.6	4.5	5.7	3.2	4.2	1.5	11.7	12.3	14.0	12.4	11.2	9.9	8.1
13 and over	80.6	79.1	79.3	84.7	90.3	93.1	77.8	70.0	69.4	71.2	75.1	70.2	78.4

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Table 91

Weather Conditions as Shown on Form 1141-A at:

Shishmaref, Alaska

(Approximately 2 to 4 Observations per day)

(Based on 3434 Obs.)

	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Ann.
General Conditions													
Lt. & Mod. Fog	7.8	9.7	5.1	13.0	12.7	12.6	14.9	9.1	7.8	3.7	2.7	3.3	8.5
Dense Fog	1.0	0.7	1.8	3.4	2.8	1.1	4.0	2.5	1.9	0.0	1.0	0.4	1.7
Thick Haze, Smoke, Dust	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip.	13.7	1.5	4.8	10.2	15.2	10.4	3.4	12.6	17.1	19.0	14.4	11.2	11.5
Thunder-storms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ceiling Height (ft.)													
0-300	20.3	11.1	11.8	11.7	11.8	12.2	7.4	13.0	14.0	11.3	13.4	12.6	12.6
301-600	6.5	3.6	3.3	4.3	10.2	9.0	4.1	8.8	11.7	4.4	8.2	6.3	6.7
601-1000	9.1	7.2	7.0	7.1	18.6	12.9	7.8	10.9	15.6	9.5	10.0	12.3	10.7
1001-2000	2.3	3.6	4.8	2.8	9.0	9.0	6.1	13.0	17.5	17.5	12.4	10.0	9.0
2001-5000	10.8	6.5	8.8	9.6	9.0	9.7	9.8	17.5	18.7	21.5	24.0	14.9	13.4
5001-9750	7.2	0.4	1.1	0.9	1.6	1.8	4.1	3.8	1.6	7.3	0.7	1.1	2.6
Over 9750	43.8	67.6	63.2	63.6	39.8	45.3	60.7	33.0	21.0	28.5	31.3	42.7	45.1
Visibility (mi.)													
0, 1/8	7.5	6.1	5.5	5.6	5.6	3.2	2.7	2.5	1.9	0.0	1.0	1.1	3.6
1/5, 1/4	2.3	0.4	2.2	1.2	2.5	0.4	1.7	0.0	0.8	0.0	0.3	0.4	1.0
1/2	4.6	2.2	2.6	5.2	3.4	4.0	3.1	0.7	0.8	0.0	1.0	0.4	2.3
3/4, 1	5.9	2.5	3.3	3.4	7.5	4.7	3.1	2.5	1.9	1.8	1.7	8.2	3.9
1 1/4 to 2 inc.	2.9	2.2	2.2	7.1	3.7	2.5	0.3	0.7	0.4	0.4	3.1	0.7	2.2
2 1/2 to 6 inc.	7.5	5.7	2.2	4.3	6.8	7.9	4.4	5.6	4.7	3.7	6.9	6.3	5.5
7 to 12 inc.	21.6	11.5	10.9	13.0	14.0	13.3	4.0	12.6	26.1	17.1	17.5	8.5	14.7
13 and over	47.7	69.4	69.1	60.2	56.5	64.0	80.7	75.4	63.4	77.0	68.4	74.3	66.8

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Table 92

Weather Conditions as Shown on Form 1141-A at:

Solomon, Alaska

(Based on 10028 Obs.)

	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Ann.
General Conditions													
Lt. & Mod. Fog	3.0	1.4	2.1	4.4	4.7	4.7	2.4	6.8	7.1	8.4	3.0	7.2	4.7
Dense Fog	0.0	0.2	0.0	0.2	0.0	0.1	0.8	0.1	0.0	0.0	0.2	0.1	0.2
Thick Haze, Smoke, Dust	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip.	5.2	2.5	5.8	7.4	11.2	5.9	1.6	10.2	10.5	11.1	2.4	9.0	6.9
Thunder-storms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ceiling Height (ft.)													
0-300	10.0	10.3	11.5	6.0	13.8	8.9	7.8	11.9	11.4	5.6	10.6	11.7	10.0
301-600	3.3	2.9	4.2	5.2	3.8	2.4	1.2	4.9	4.5	5.2	2.8	4.5	3.8
601-1000	12.6	4.6	7.8	7.4	9.6	5.1	4.2	11.2	9.6	9.9	6.5	8.7	8.1
1001-2000	6.7	5.5	5.5	3.5	4.8	5.2	3.5	9.4	8.5	7.1	3.5	4.6	5.7
2001-5000	15.2	9.5	13.0	16.4	16.3	18.3	14.3	24.1	23.9	22.5	23.0	16.4	17.8
5001-9750	2.4	1.8	2.4	4.5	3.3	2.6	3.0	1.5	1.9	4.4	4.9	2.8	3.0
Over 9750	49.7	65.4	55.6	57.1	48.4	57.5	65.9	37.1	40.2	45.3	48.7	51.2	51.8
Visibility (mi.)													
0, 1/8	7.1	7.8	7.5	6.3	8.1	4.1	3.1	6.1	5.1	3.6	5.8	5.9	5.1
1/5, 1/4	0.0	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	+
1/2	0.4	0.8	1.8	1.8	2.3	0.6	1.1	0.8	0.8	0.5	0.7	1.9	1.1
3/4, 1	1.4	1.7	3.8	2.1	3.3	0.0	1.1	1.9	1.6	1.5	1.2	0.0	1.6
1 1/4 to 2 inc.	1.9	0.8	1.1	3.7	2.2	2.6	1.5	2.3	1.7	1.9	1.8	2.1	2.0
2 1/2 to 6 inc.	3.4	2.6	3.9	6.1	3.4	3.6	2.4	3.3	4.8	6.5	3.3	7.2	4.4
7 to 12 inc.	11.6	6.9	6.8	8.1	10.2	7.0	6.3	8.9	9.6	9.6	6.5	6.6	8.2
13 and over	74.1	79.4	75.3	77.8	70.5	82.0	84.7	74.8	76.4	80.3	80.6	76.2	77.6

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Table 93

Weather Conditions as Shown on Form 1141-A at:

Tanana, Alaska

(Based on 8403 Obs.)

	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Ann.
General Conditions													
Lt. & Mod. Fog	2.8	1.2	1.4	2.0	0.3	0.1	0.0	0.2	2.0	0.8	1.8	1.2	1.2
Dense Fog	2.2	1.5	1.2	0.0	0.1	0.1	0.2	0.2	3.0	2.2	2.3	1.2	1.2
Thick Haze, Smoke, Dust	0.0	0.0	0.1	0.0	0.0	0.0	0.2	0.5	0.0	0.0	0.0	0.0	0.1
Precip.	7.8	9.7	6.5	7.1	2.9	4.6	12.6	13.6	19.6	16.6	14.4	11.8	10.6
Thunderp storms	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	+
Ceiling Height (ft.)													
0-300	3.3	4.2	2.2	0.6	0.7	0.8	2.8	1.0	4.5	4.9	5.8	5.3	3.0
301-600	1.2	2.8	2.2	1.6	0.2	0.5	0.0	1.6	0.5	1.2	4.1	2.5	1.6
601-1000	3.6	4.6	3.1	3.2	0.8	3.3	2.8	4.7	6.2	4.7	4.6	5.3	3.9
1001-2000	13.3	7.5	9.6	6.8	7.7	3.9	9.3	17.1	25.1	17.1	19.0	13.0	12.4
2001-5000	19.5	13.9	16.9	15.1	18.2	17.2	22.8	19.1	27.1	28.4	24.6	23.1	20.5
5001-9750	5.7	4.4	13.6	13.8	11.7	5.7	10.3	7.4	7.5	8.1	4.6	5.1	8.2
Over 9750	53.4	62.6	52.4	58.9	60.8	68.7	51.9	49.1	29.0	35.6	37.4	45.8	50.5
Visibility (mi.)													
0, 1/8	3.8	4.9	4.3	1.1	0.8	4.1	5.3	5.5	7.4	8.2	8.7	7.6	5.2
1/5, 1/4	0.0	0.5	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1
1/2	0.9	0.4	0.4	0.6	0.2	0.0	0.0	0.0	0.3	0.2	0.5	1.1	0.4
3/4, 1	0.9	1.5	1.0	0.9	0.1	0.0	0.0	0.5	0.0	0.2	2.3	1.2	0.7
1 1/4 to 2 inc.	0.7	0.5	1.1	0.5	0.2	0.5	0.2	0.2	0.3	0.2	0.3	0.7	0.4
2 1/2 to 6 inc.	4.3	4.0	2.5	3.2	2.0	1.2	1.2	2.6	3.0	1.8	3.6	2.3	2.7
7 to 12 inc.	9.7	6.7	5.8	4.9	4.3	11.7	8.5	12.1	15.9	14.1	11.6	9.2	9.6
13 and over	79.8	81.5	84.9	83.8	92.5	82.5	84.7	79.1	73.0	75.3	73.1	77.8	81.1

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Table 94

Weather Conditions as Shown on Form 1141-A at:

Wales (Tin City), Alaska

(Approximately 1 to 3 Observations per day)

	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Ann.
General Conditions													
Lt. & Mod. Fog	3.2	5.1	4.4	3.8	18.7	10.7	11.1	25.5	15.3	2.8	3.2	1.3	9.8
Dense Fog	0.0	0.8	0.0	0.4	2.6	1.2	1.1	2.1	1.1	0.6	0.5	0.0	0.9
Thick Haze, Smoke, Dust	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip.	14.5	4.3	13.7	9.8	5.2	6.5	5.0	8.3	12.2	6.8	10.9	15.1	9.4
Thunder-storms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ceiling Height (ft.)													
0-300	11.3	7.1	13.3	7.7	6.9	3.0	2.8	7.3	6.3	3.4	3.6	8.0	6.7
301-600	6.0	4.3	1.8	2.6	2.6	1.8	1.1	5.7	2.1	4.0	4.5	7.1	3.6
601-1000	9.3	7.1	4.9	4.7	4.3	6.0	6.1	10.4	7.4	3.4	5.0	9.7	6.5
1001-2000	17.7	10.2	8.0	13.7	21.7	6.0	9.5	24.0	17.5	25.0	13.1	8.0	14.6
2001-5000	12.9	7.5	11.1	10.7	25.2	26.8	20.7	23.4	37.6	34.1	45.3	23.5	23.2
5001-9750	2.8	0.4	2.2	6.4	4.3	11.9	11.7	8.9	10.1	7.4	6.8	8.0	6.8
Over 9750	39.9	63.5	58.9	54.3	35.2	44.6	48.0	20.3	19.0	22.7	21.7	35.7	38.7
Visibility (mi.)													
0, 1/8	8.1	4.7	9.3	4.3	6.1	2.4	0.5	5.2	2.1	1.1	0.9	1.7	3.9
1/8, 1/4	5.2	2.0	1.8	0.4	0.9	0.0	0.5	1.6	1.1	0.0	0.9	0.8	1.9
1/2	3.6	3.5	2.2	4.7	1.7	0.0	3.4	6.8	4.8	2.8	2.3	0.8	3.1
3/4, 1	10.5	10.6	5.8	8.1	5.2	6.0	1.7	5.7	3.7	4.0	4.1	7.1	6.0
1 1/4 to 2 inc.	7.3	5.1	8.9	7.0	8.7	1.8	3.9	5.7	0.5	1.7	3.2	3.4	4.8
2 1/2 to 6 inc.	10.9	12.2	11.5	13.2	27.4	16.7	11.7	18.7	19.0	18.2	13.1	8.8	14.6
7 to 12 inc.	4.8	6.7	4.4	5.6	1.0	6.0	5.0	14.6	18.5	15.9	7.2	7.1	8.8
13 and over	49.6	55.3	56.2	56.4	40.0	57.3	73.2	41.7	50.3	56.3	68.3	71.2	57.1

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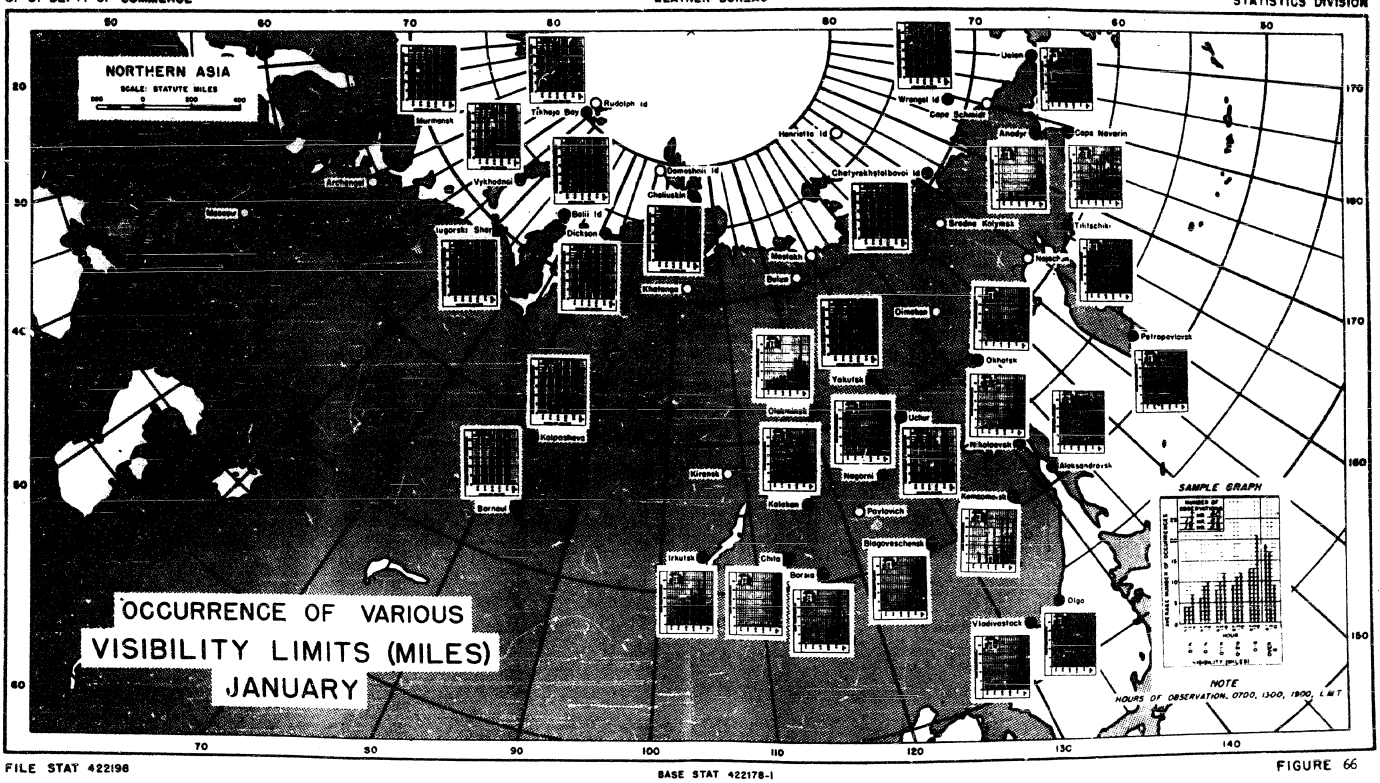

FILE STAT 422198 — BASE STAT 422178-1 — FIGURE 66

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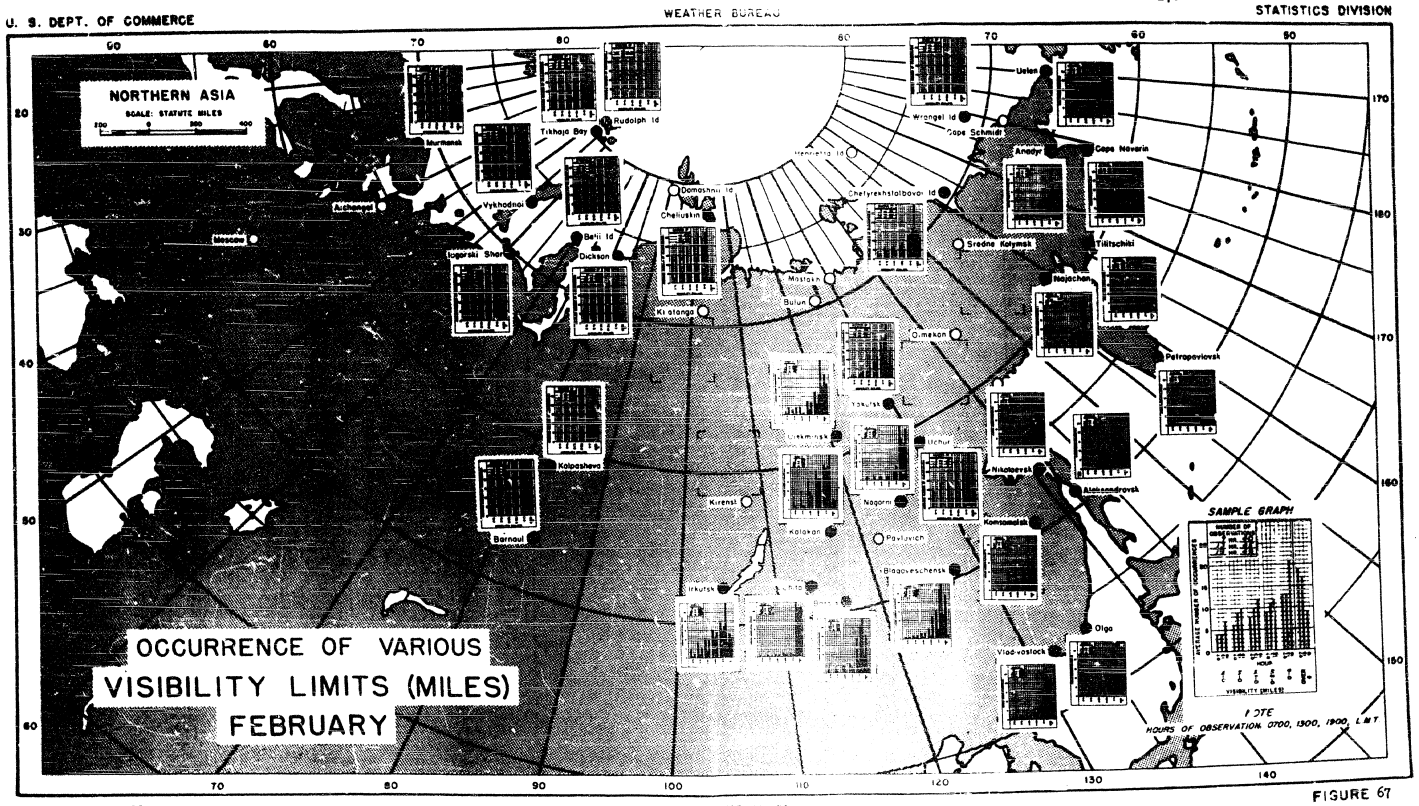

FILE STAT 422190 — BASE STAT 422178-1 — FIGURE 67

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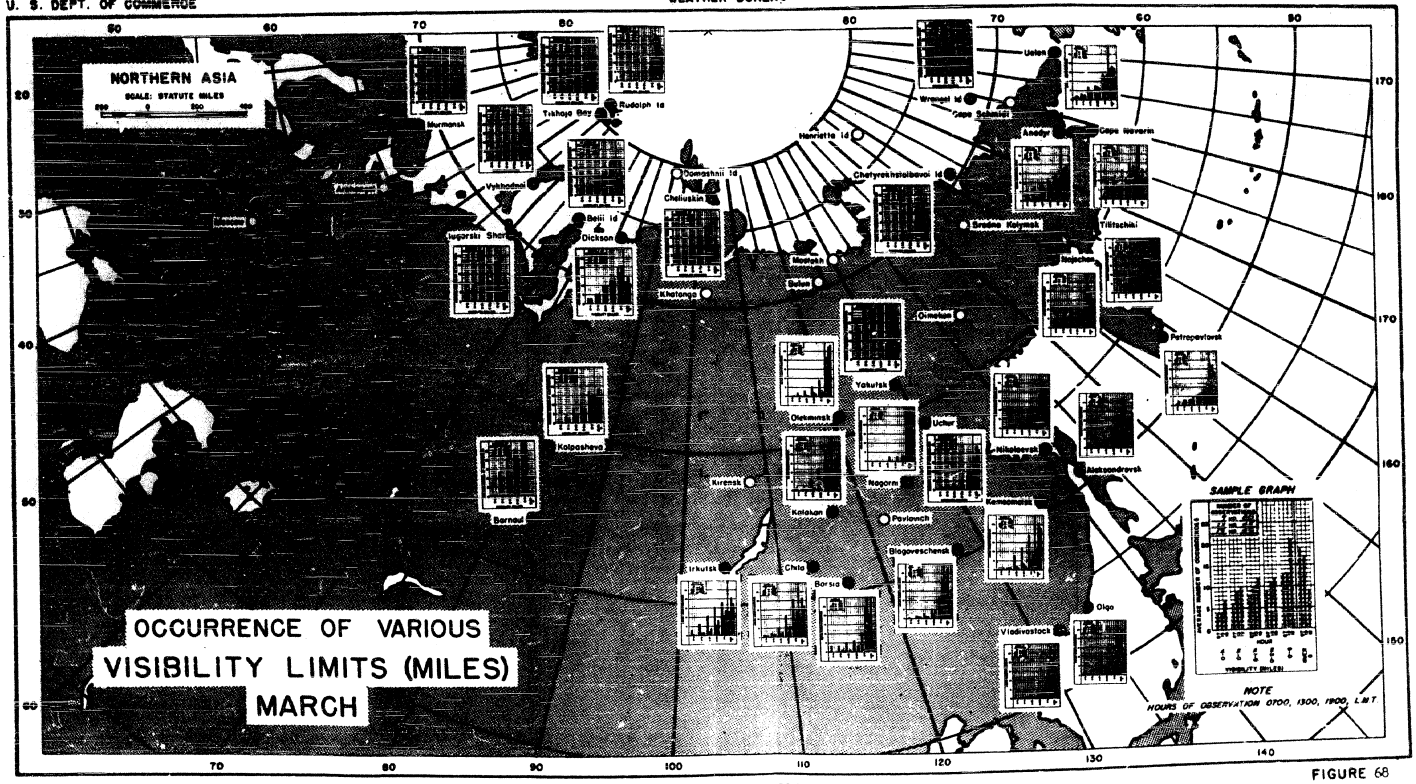

FILE STAT 422200 — BASE STAT 422178-1 — FIGURE 68

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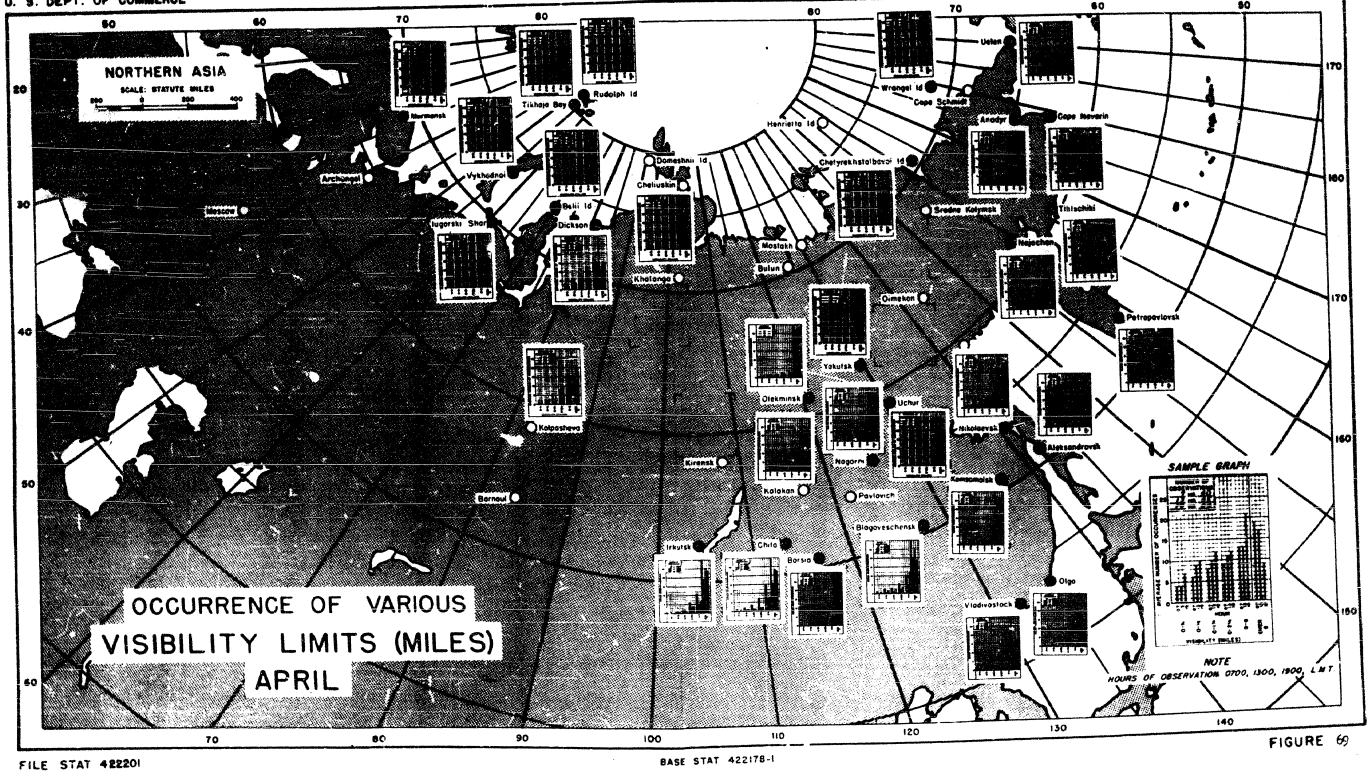

FILE STAT 422201 — BASE STAT 422178-1 — FIGURE 69

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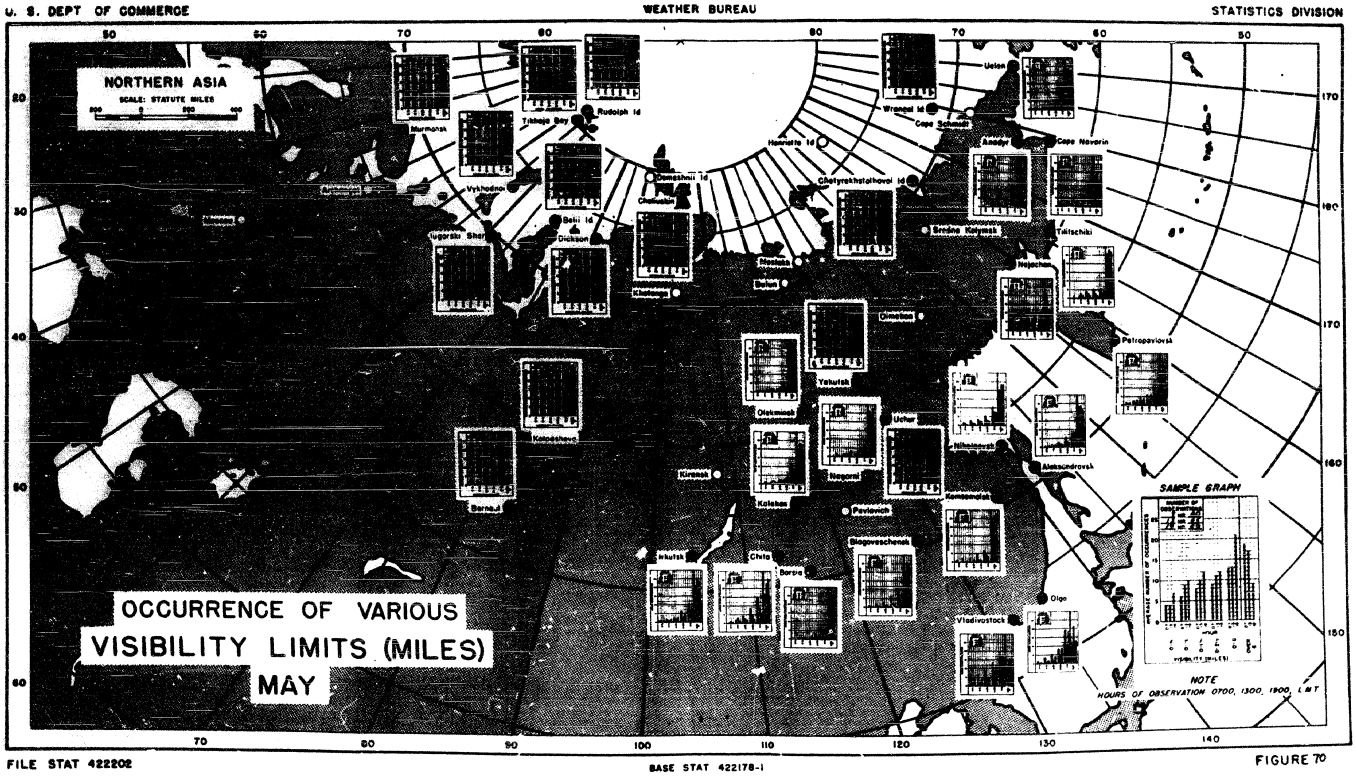

FILE STAT 422202 BASE STAT 422178-1 FIGURE 70

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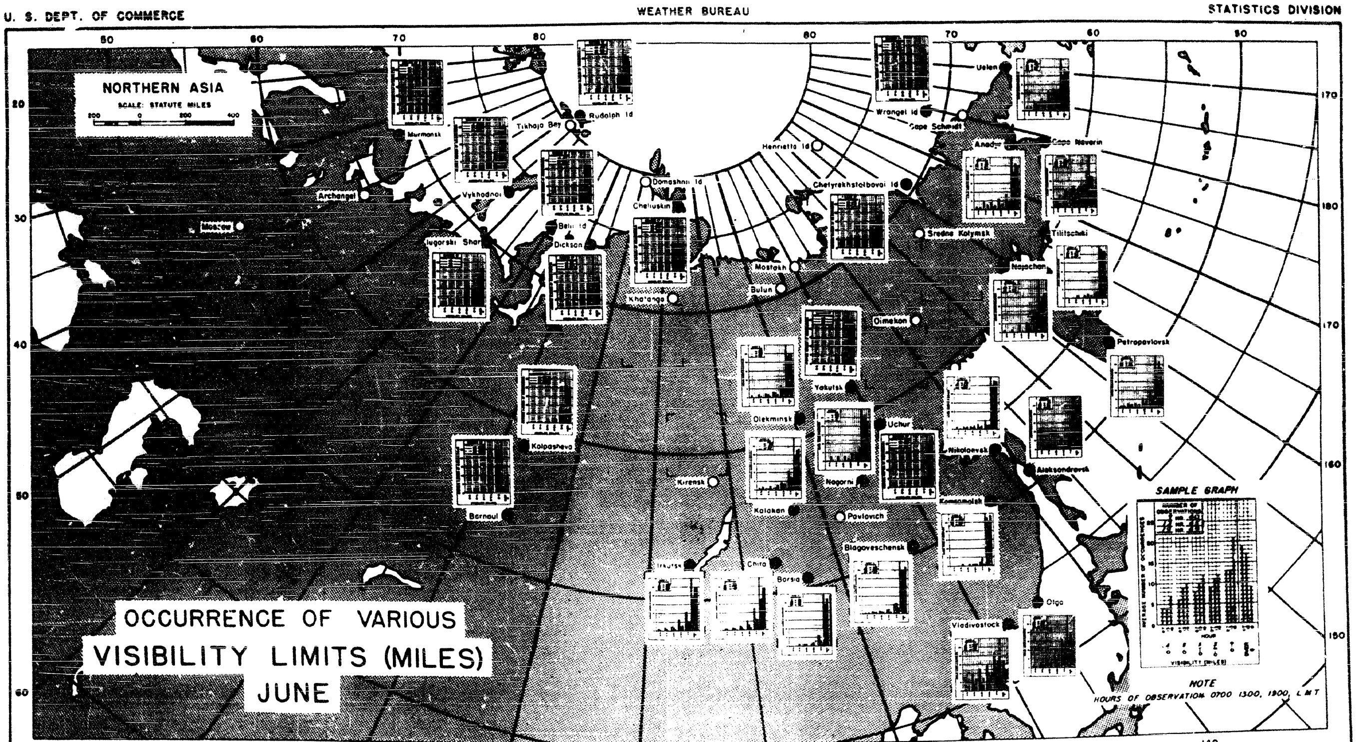

FILE STAT 422203

BASE STAT 422178-1

FIGURE 71

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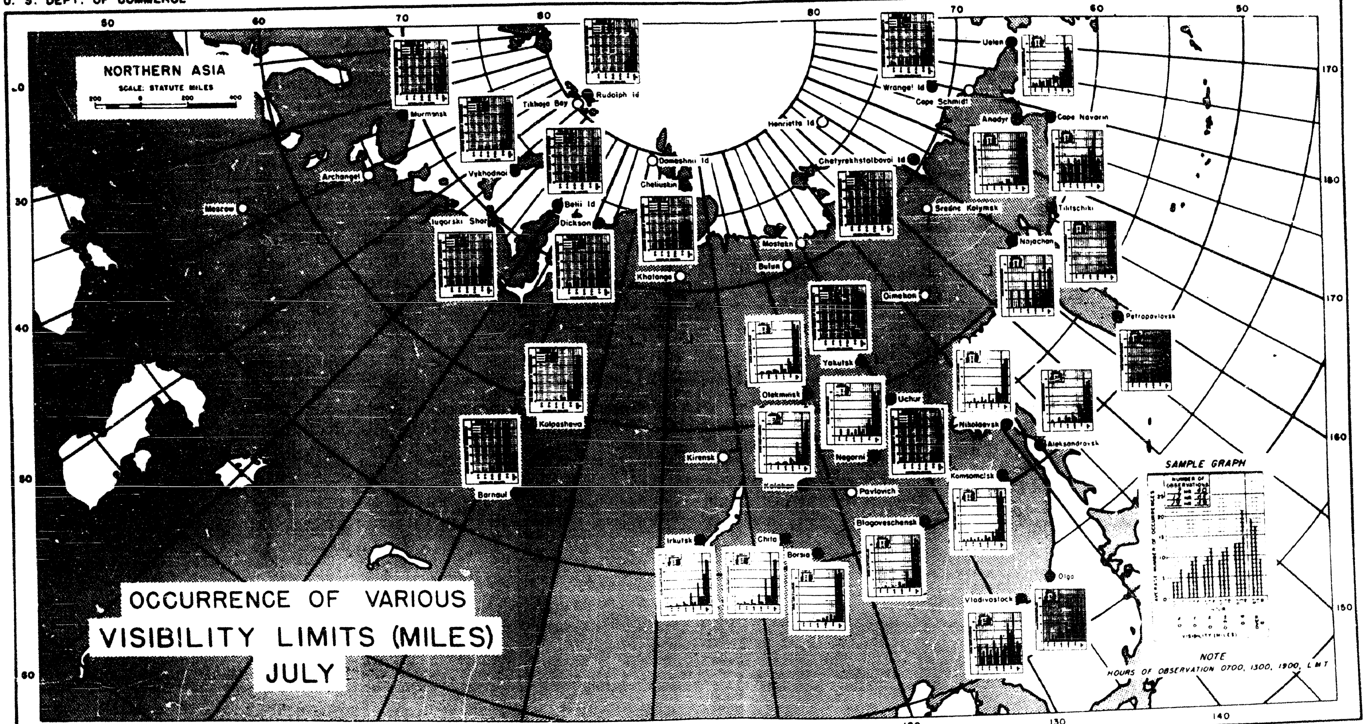

FILE STAT 422204

BASE STAT 422178-1

FIGURE 72

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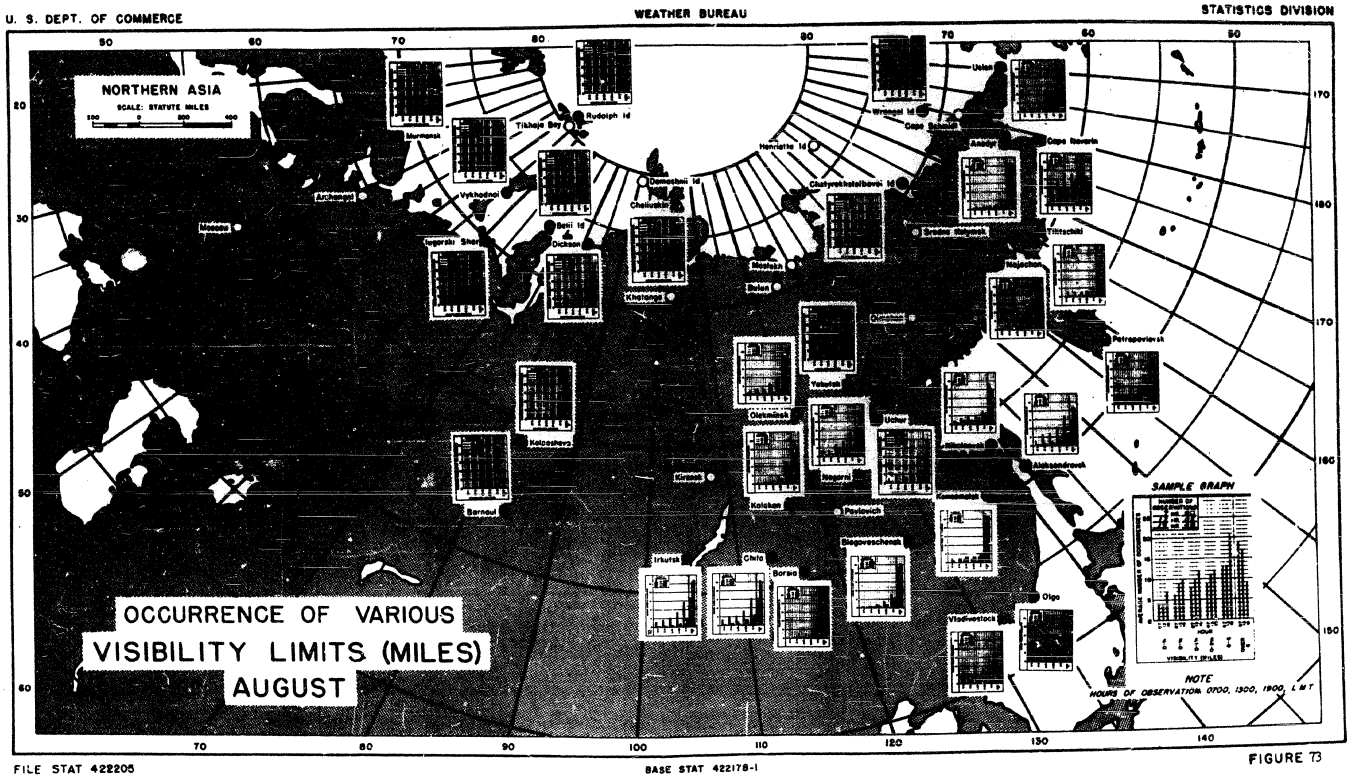

FILE STAT 422205 BASE STAT 422178-1 FIGURE 73

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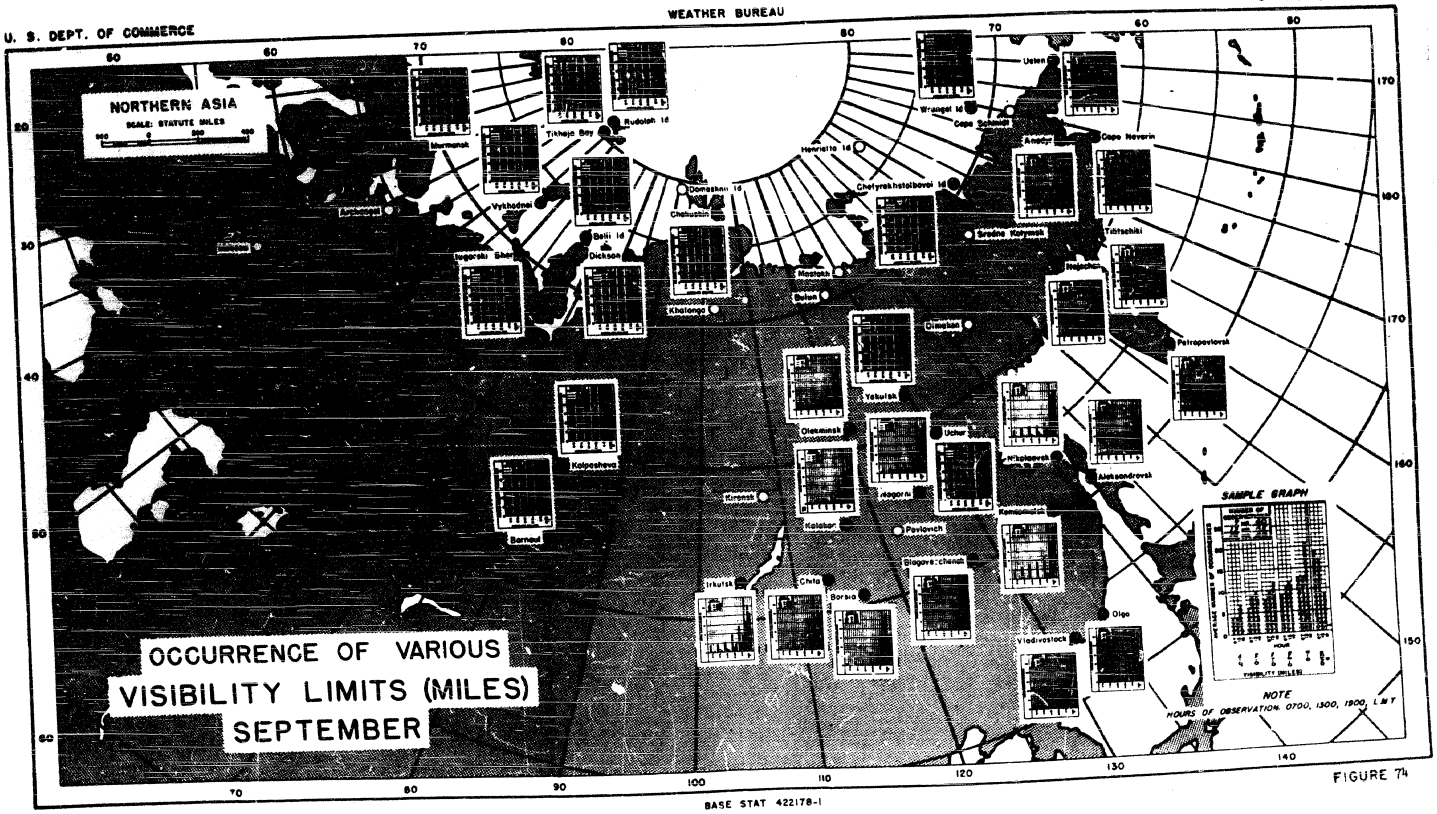

FIGURE 74

BASE STAT 422178-1

FILE STAT 422206

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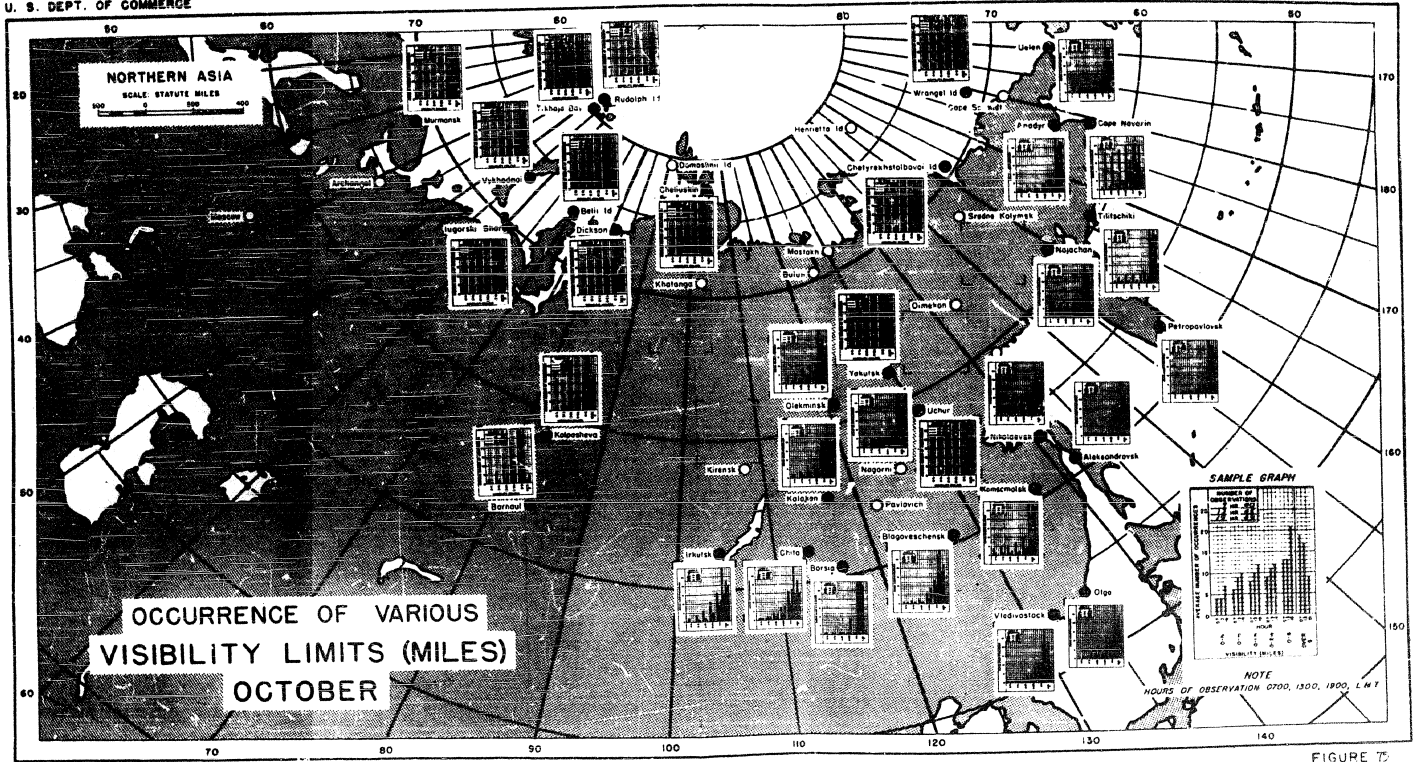

FILE STAT 422207 — BASE STAT 422178-1 — FIGURE 75

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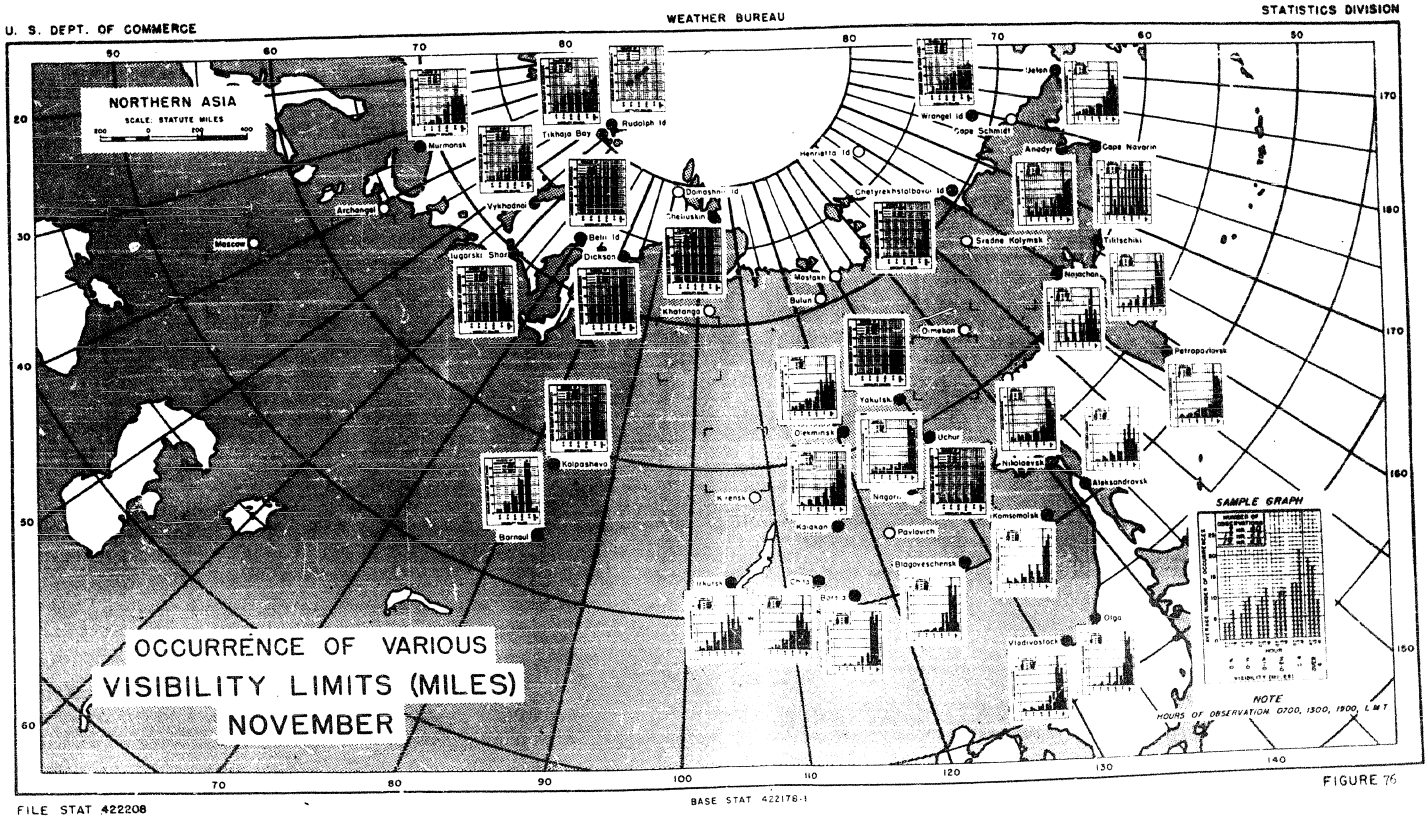

FILE STAT 422208 — BASE STAT 422178-1 — FIGURE 76

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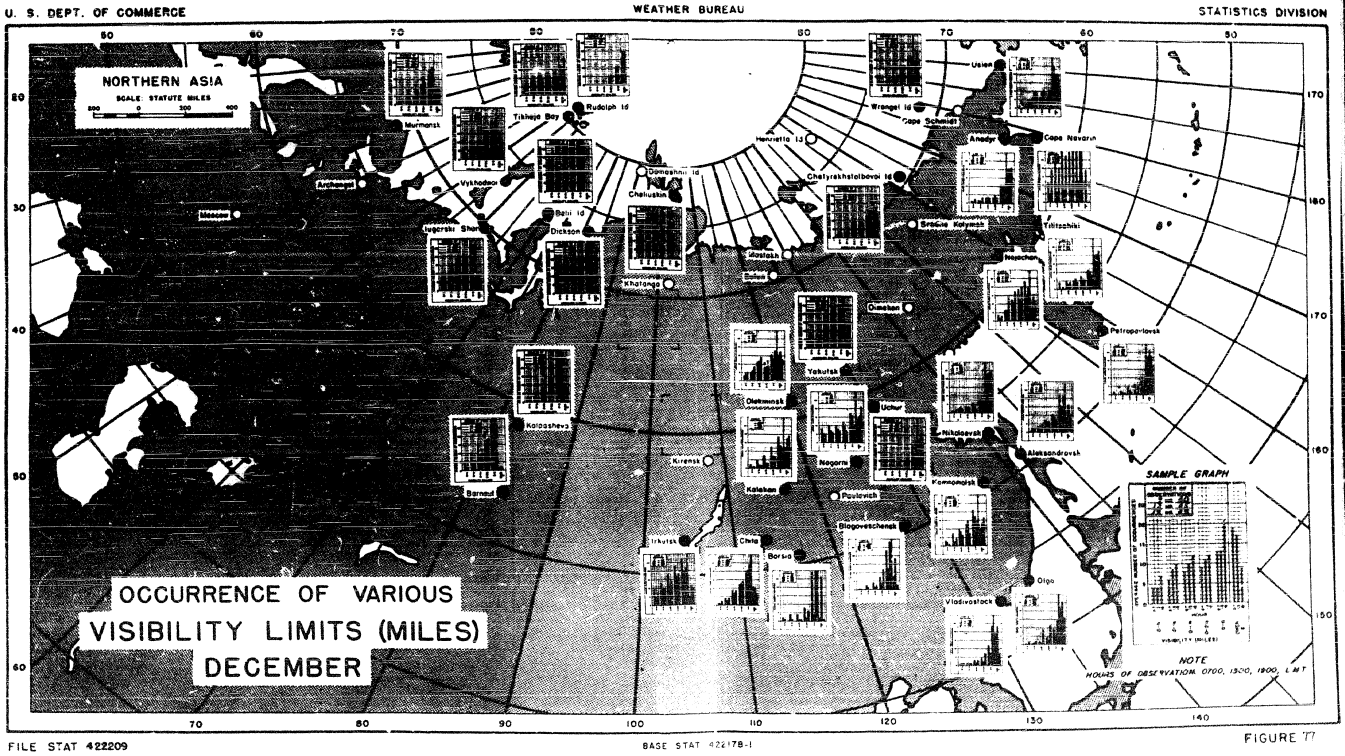

FILE STAT 422209 BASE STAT 422178-I FIGURE 77

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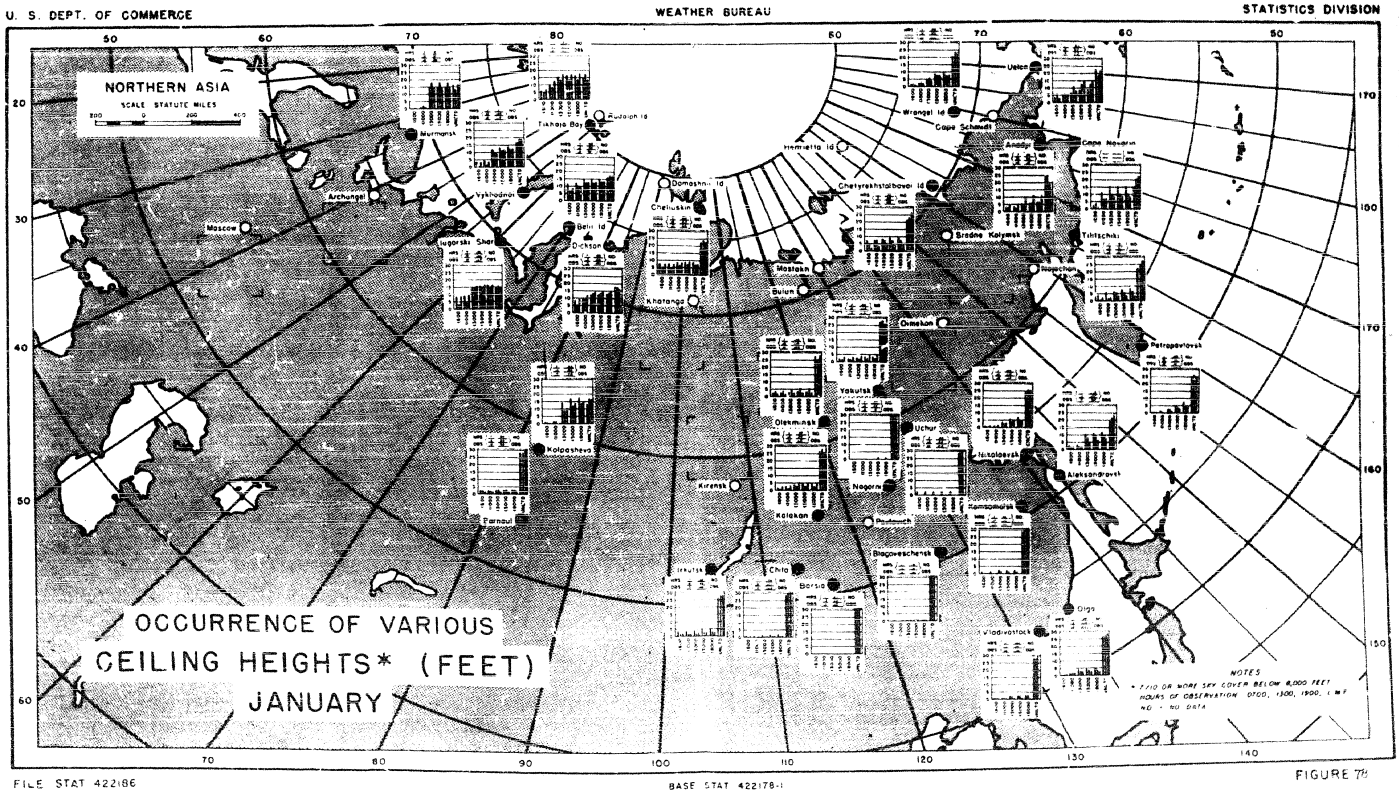

FILE STAT 422186 BASE STAT 422178-1 FIGURE 7

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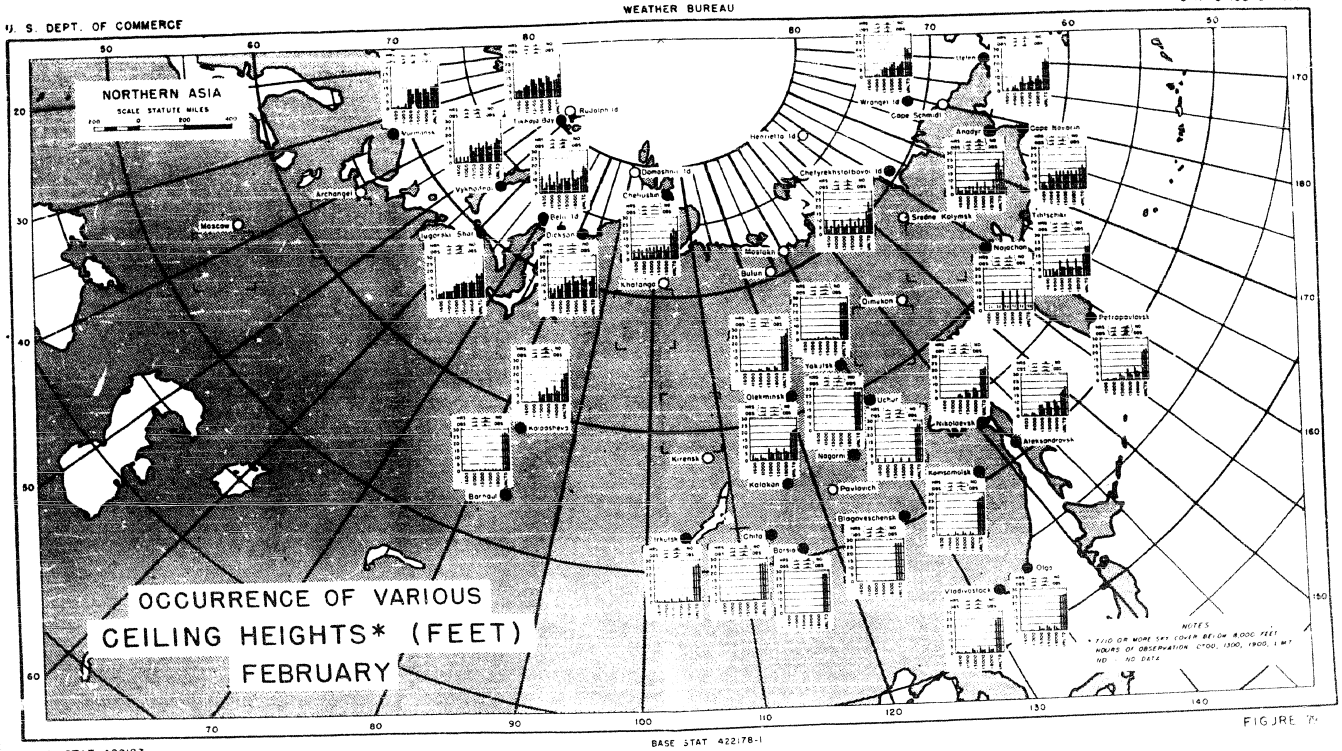

FIGURE 7

FILE STAT 422187

BASE STAT 422178-1

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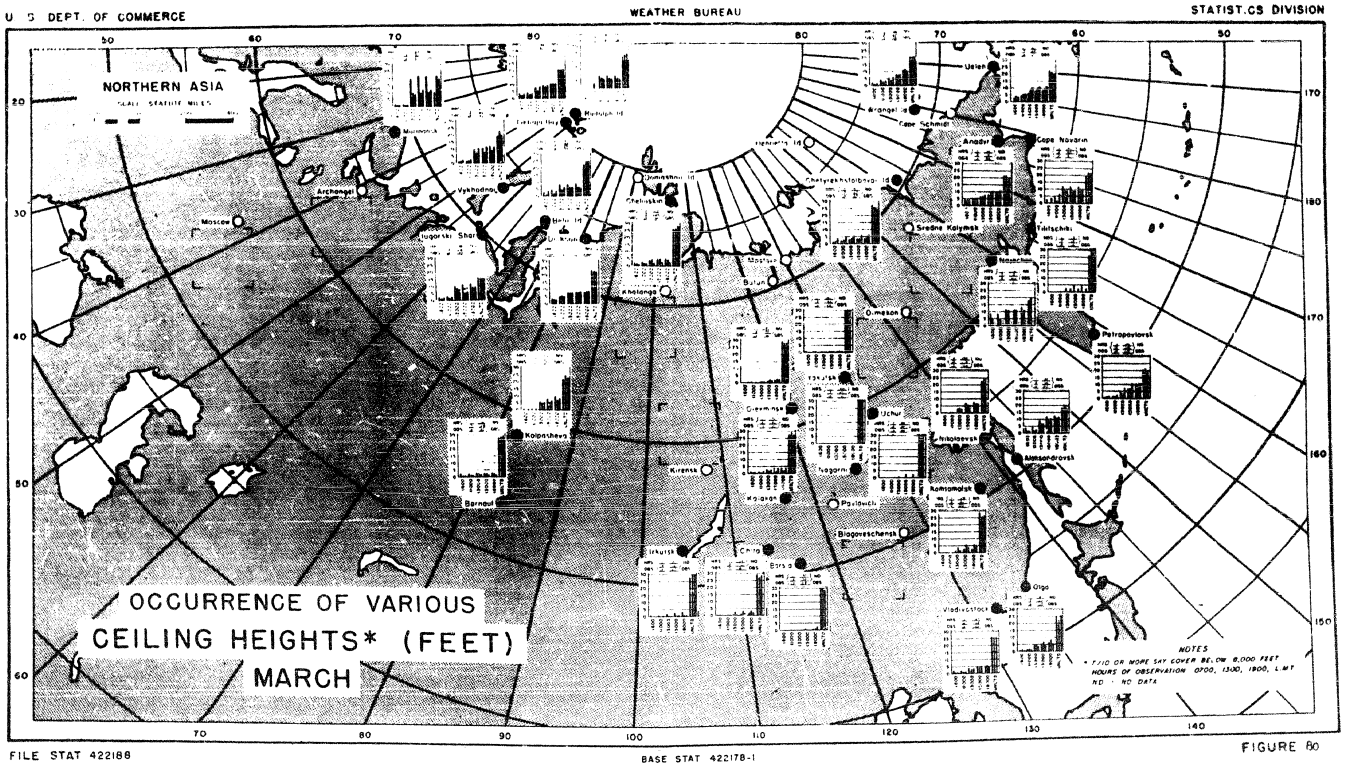
U S DEPT. OF COMMERCE WEATHER BUREAU STATIST.CS DIVISION



FILE STAT 422188 BASE STAT 422178-1 FIGURE 80

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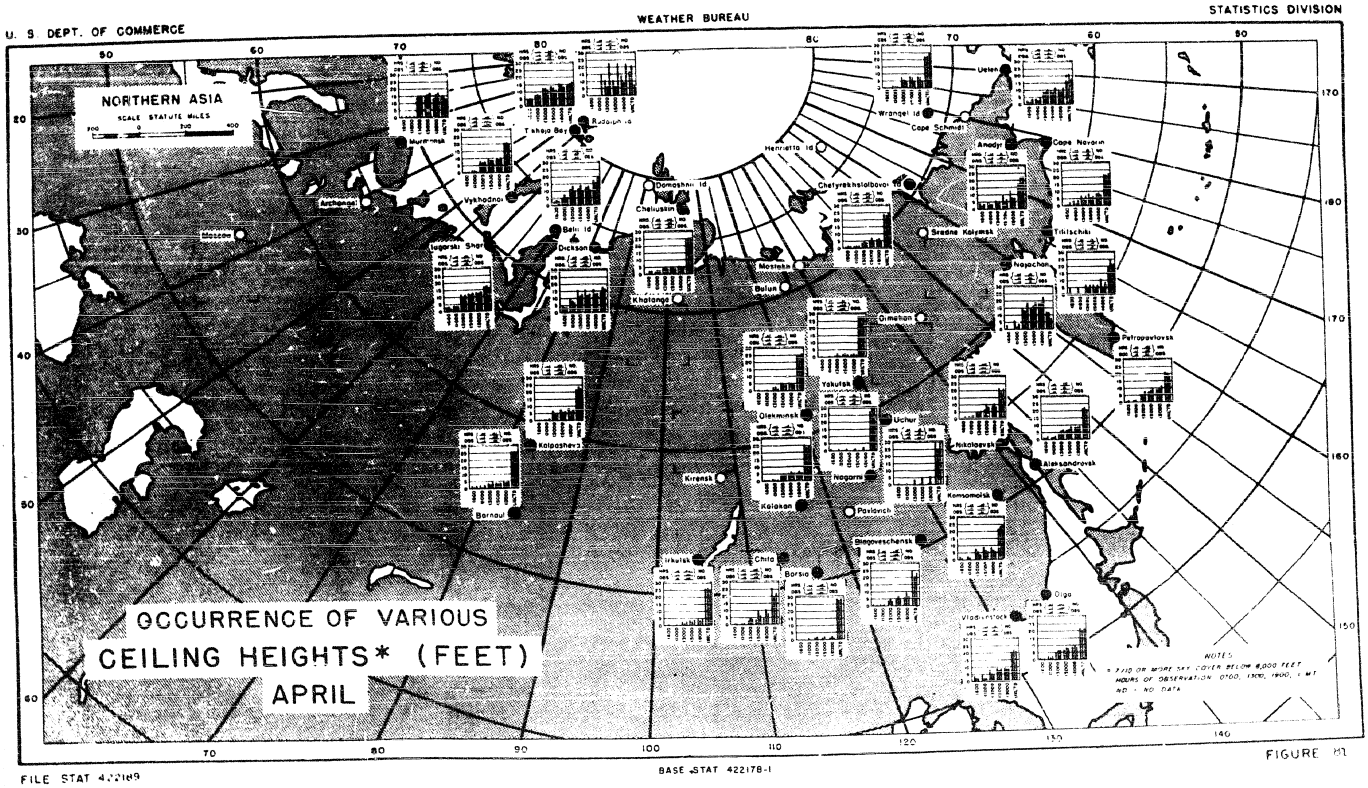

FILE STAT 422169

BASE STAT 422178-1

FIGURE 17

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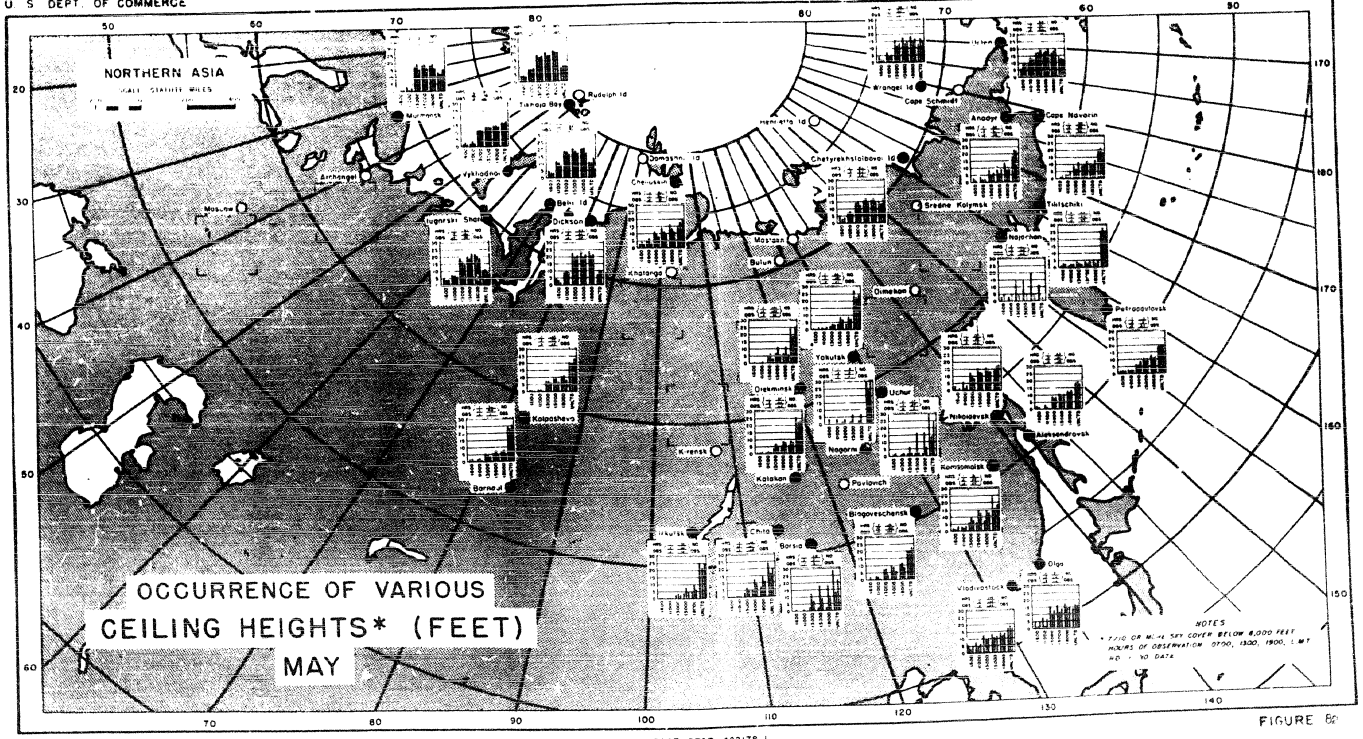
STATISTICS DIVISION



FILE STAT 422190

BASE STAT 422178-1

FIGURE 8

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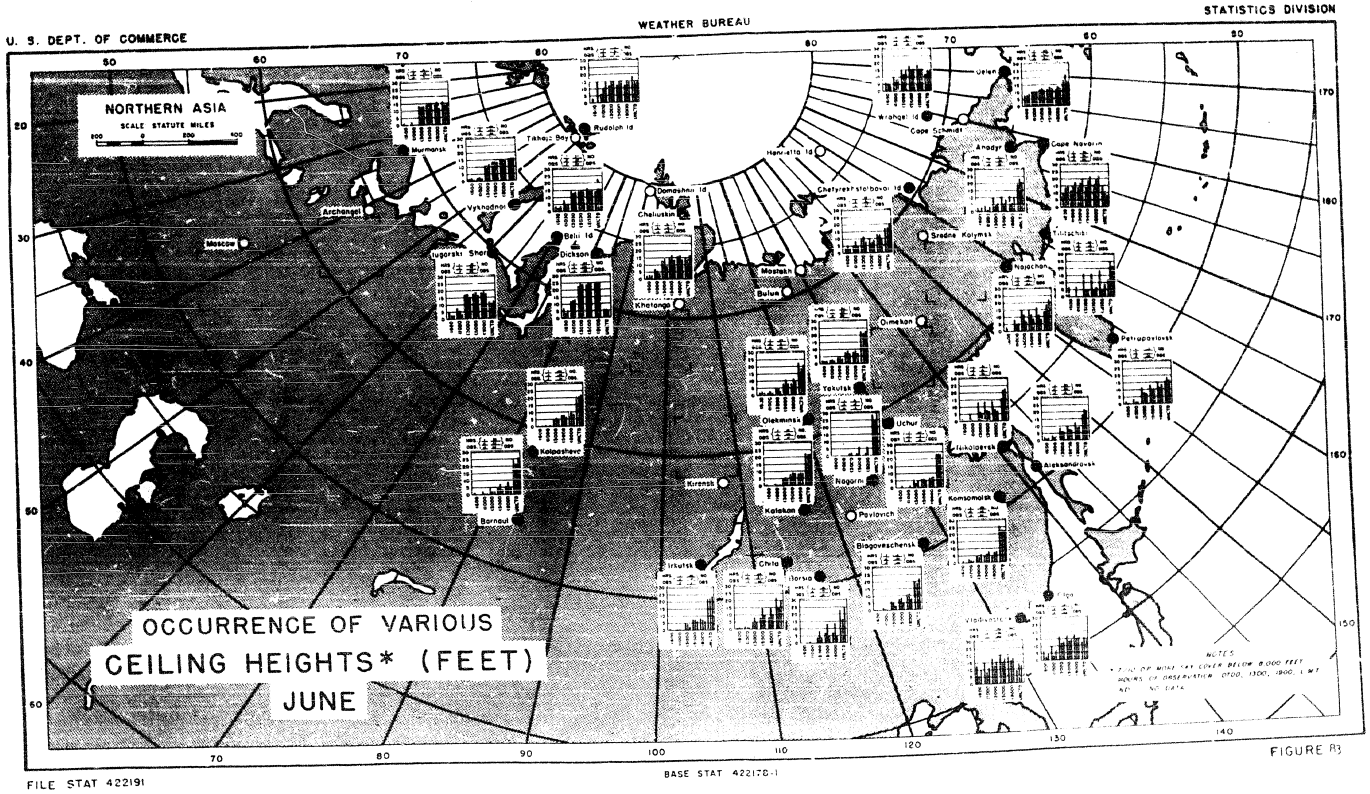
U. S. DEPT. OF COMMERCE — WEATHER BUREAU — STATISTICS DIVISION



FILE STAT 422191

BASE STAT 422170-1

FIGURE B3

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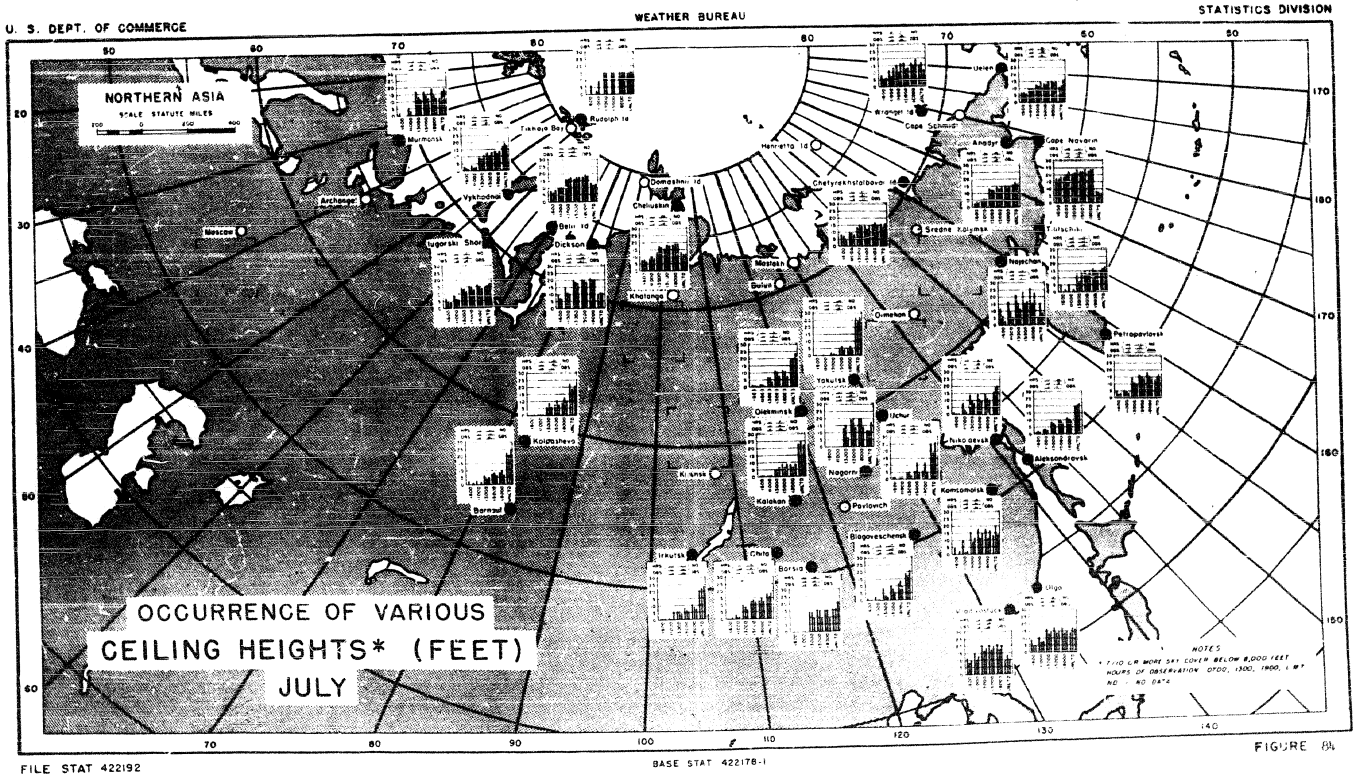
U. S. DEPT. OF COMMERCE — WEATHER BUREAU — STATISTICS DIVISION



FILE STAT 422192 — BASE STAT 422178-1 — FIGURE 84

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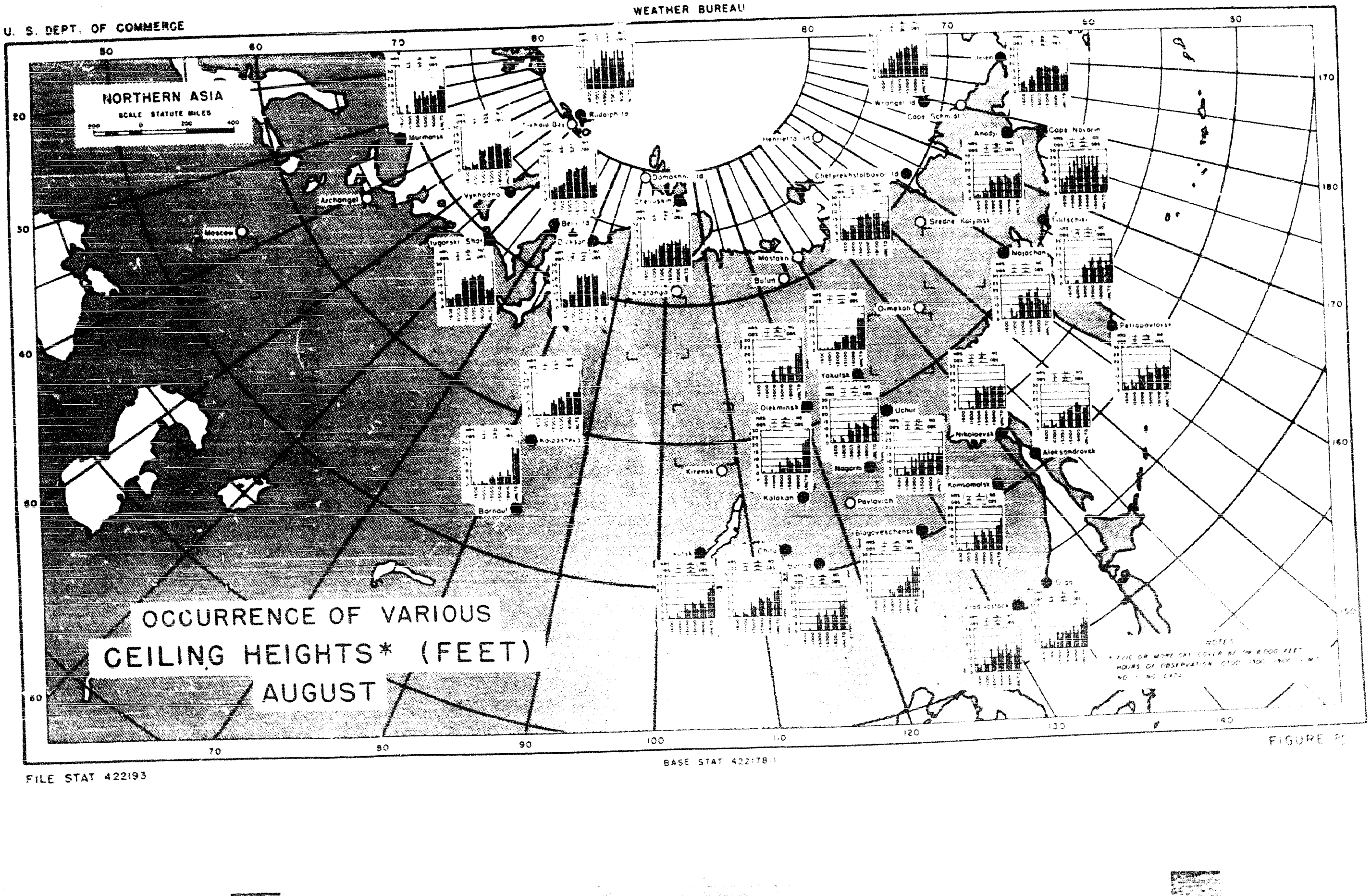
STATISTICS DIVISION



FIGURE

FILE STAT 422193

BASE STAT 422178

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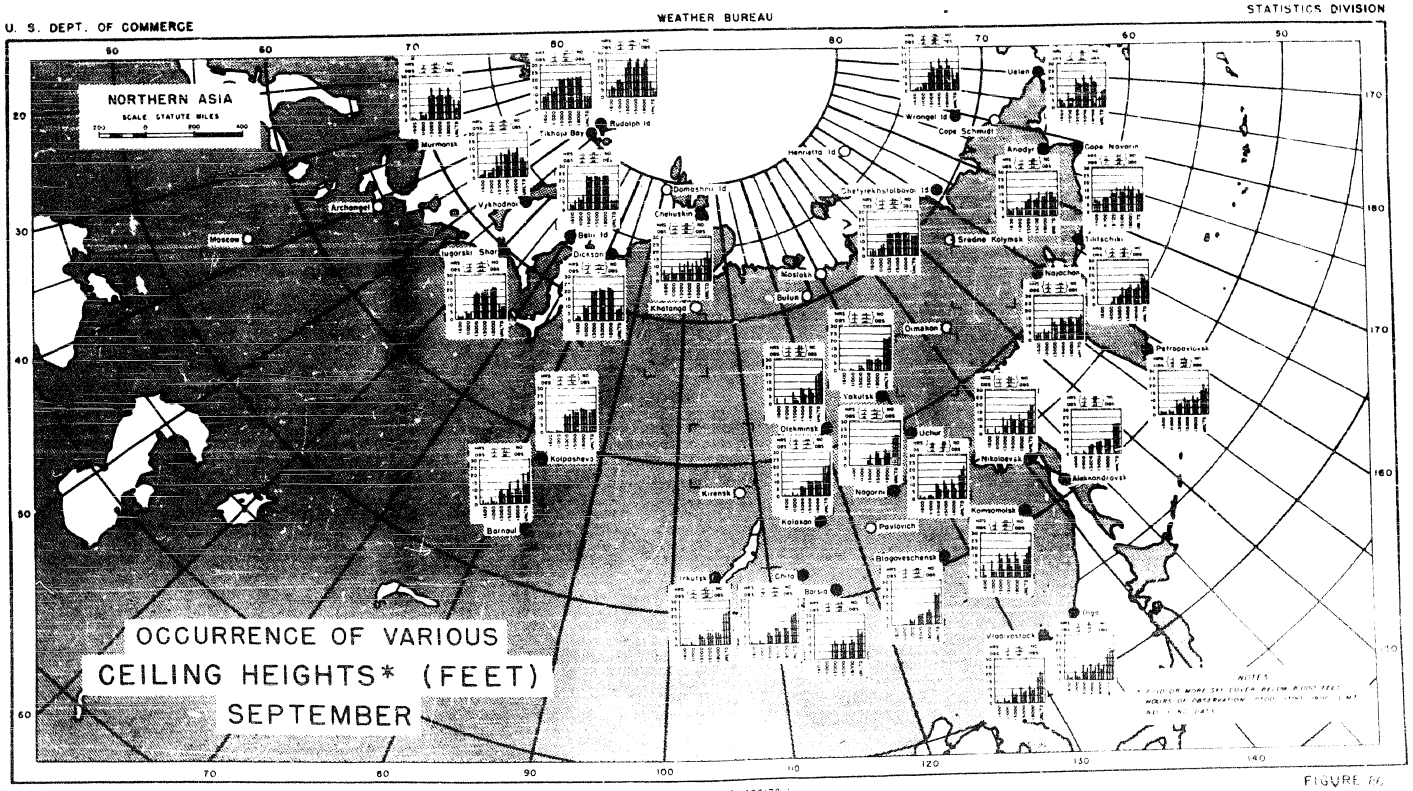
Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2014/04/24 : CIA-RDP81-01043R003500090005-5

U. S. DEPT. OF COMMERCE — WEATHER BUREAU — STATISTICS DIVISION



FILE STAT 422194 — BASE STAT 422178-1 — FIGURE 66

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2014/04/24 : CIA-RDP81-01043R003500090005-5

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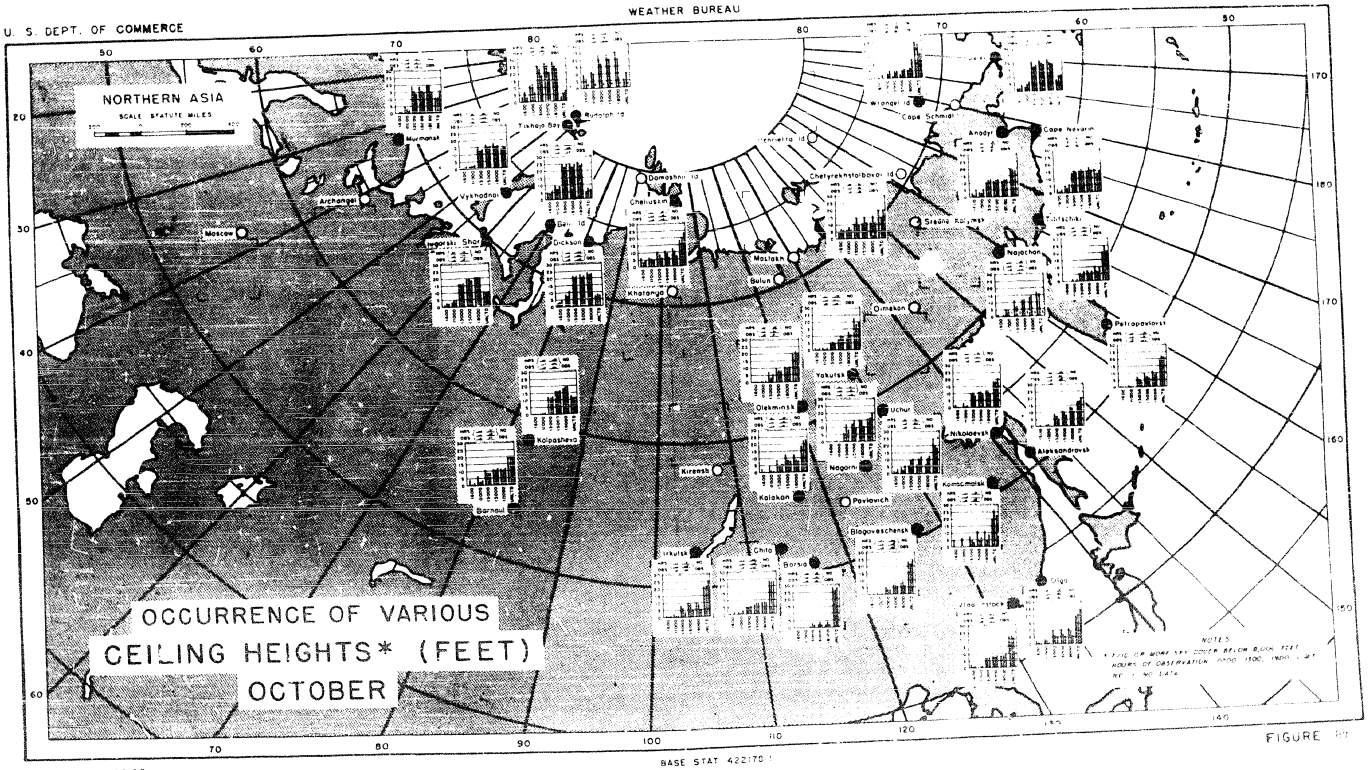
U. S. DEPT. OF COMMERCE

WEATHER BUREAU

STATISTICS DIVISION



OCCURRENCE OF VARIOUS
CEILING HEIGHTS* (FEET)
OCTOBER

FILE STAT 422195

BASE STAT 422170

FIGURE

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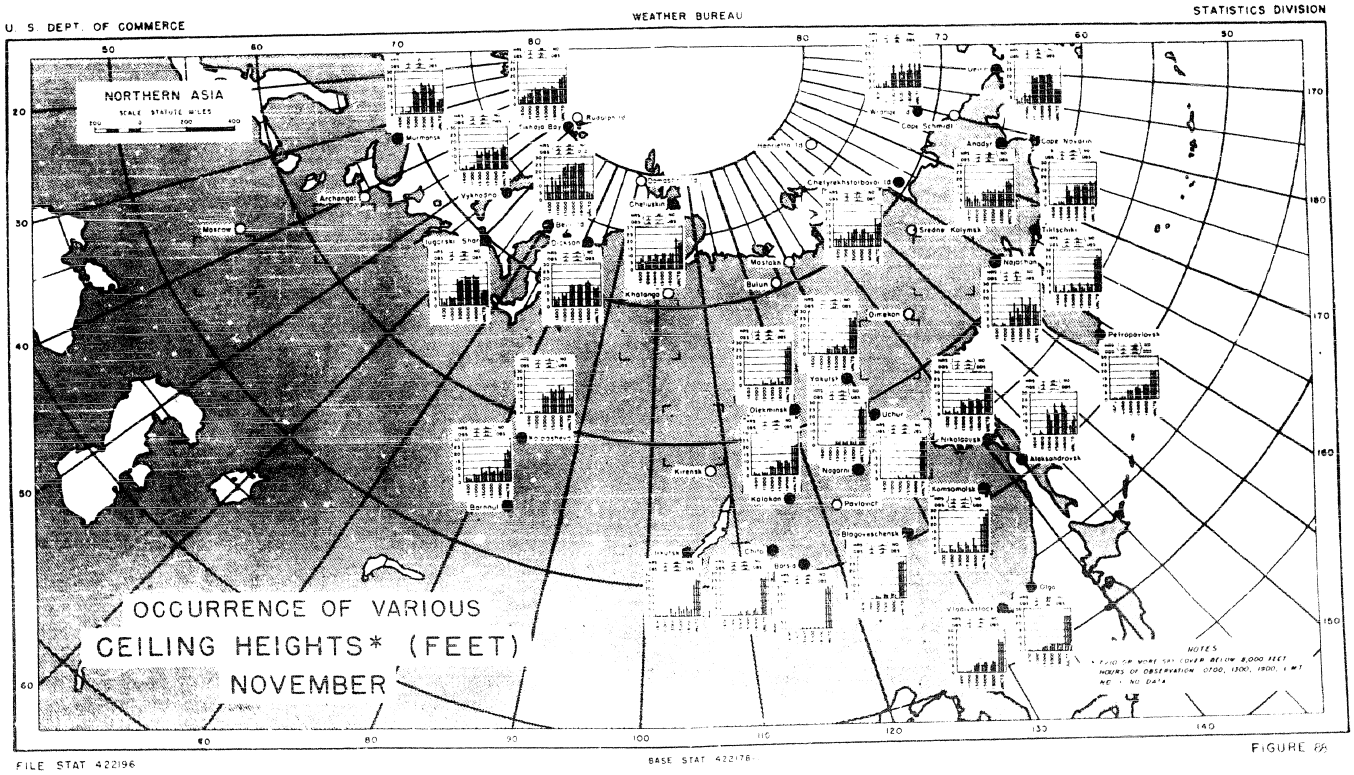
U. S. DEPT. OF COMMERCE — WEATHER BUREAU — STATISTICS DIVISION



FILE STAT 422196 — BASE STAT 422178 — FIGURE 88

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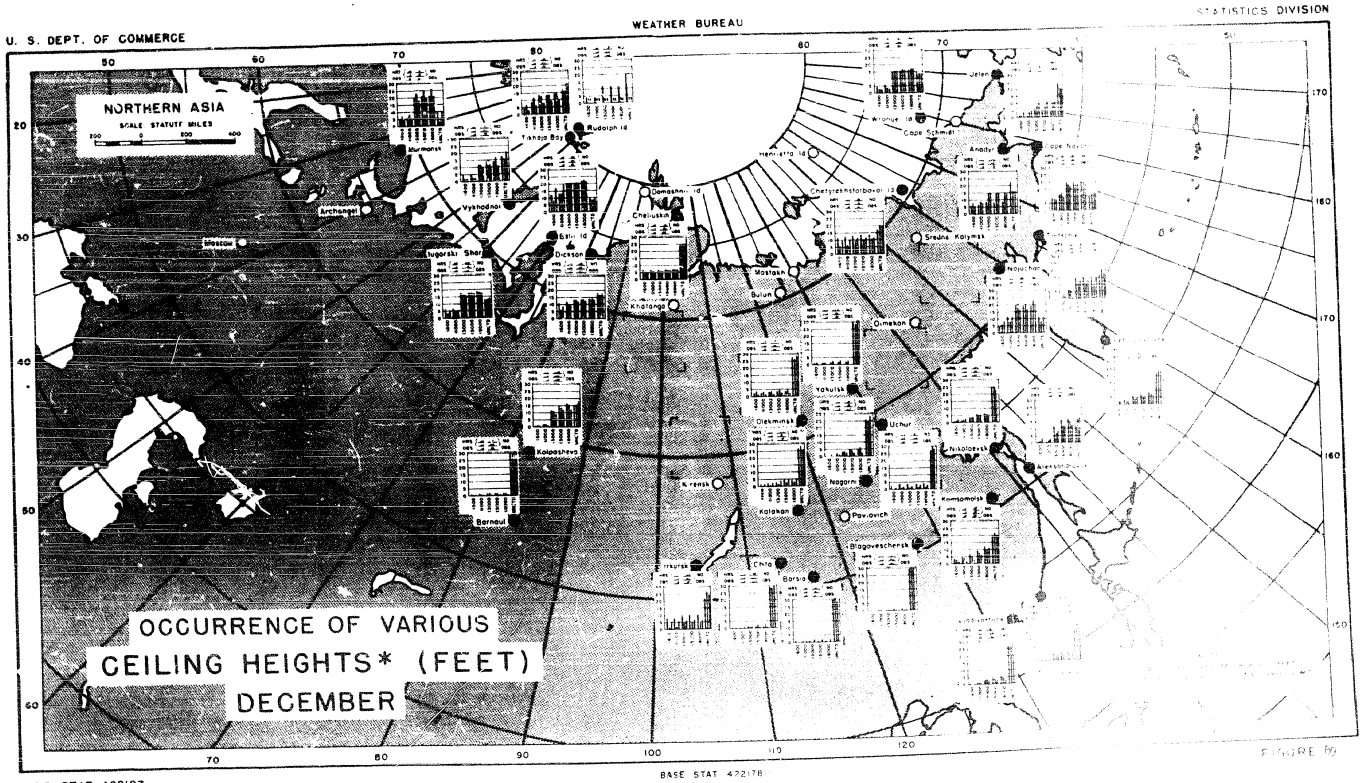
U. S. DEPT. OF COMMERCE

WEATHER BUREAU

STATISTICS DIVISION



FILE STAT 422197

BASE STAT 422178

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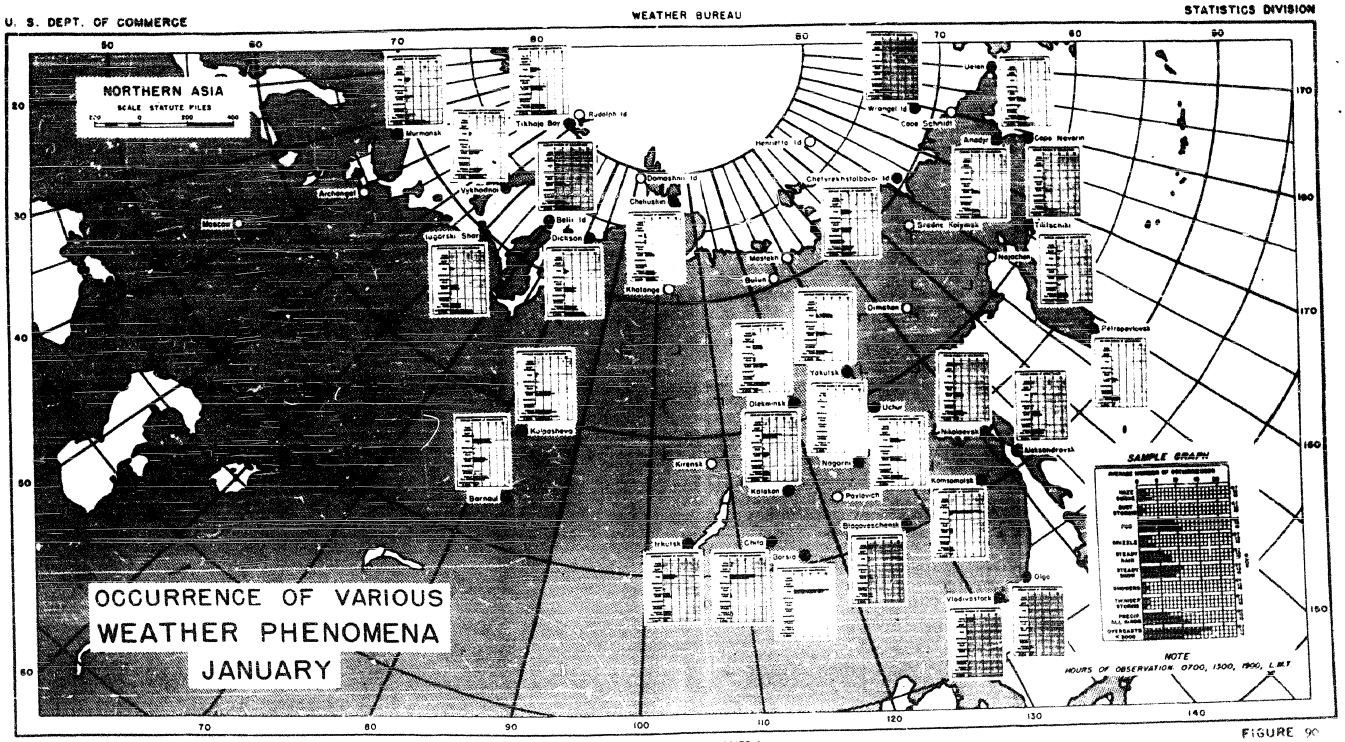
U. S. DEPT. OF COMMERCE WEATHER BUREAU STATISTICS DIVISION



FILE STAT 422210 BASE STAT 422178-1 FIGURE 90

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U. S. DEPT. OF COMMERCE · WEATHER BUREAU · STATISTICS DIVISION

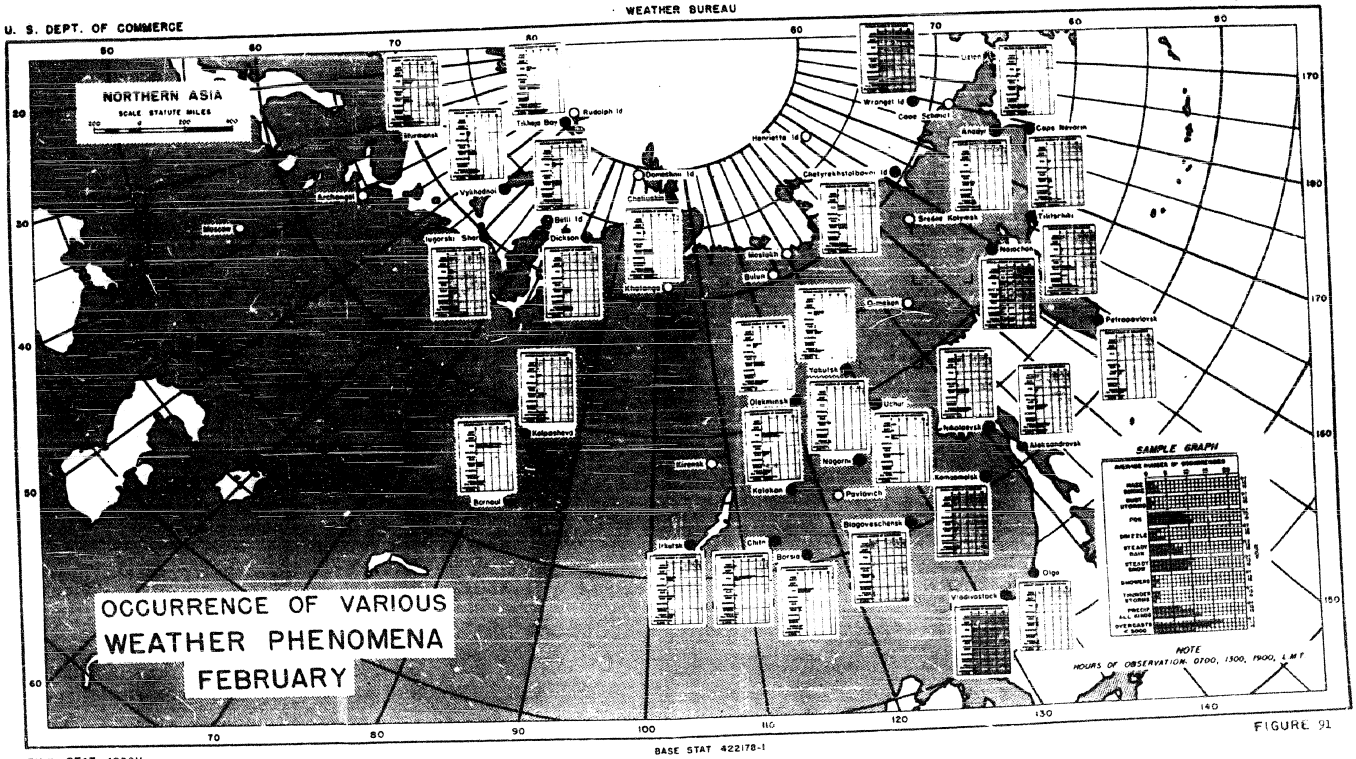

FIGURE 91

FILE STAT 422211 · BASE STAT 422178-1

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2014/04/24 : CIA-RDP81-01043R003500090005-5

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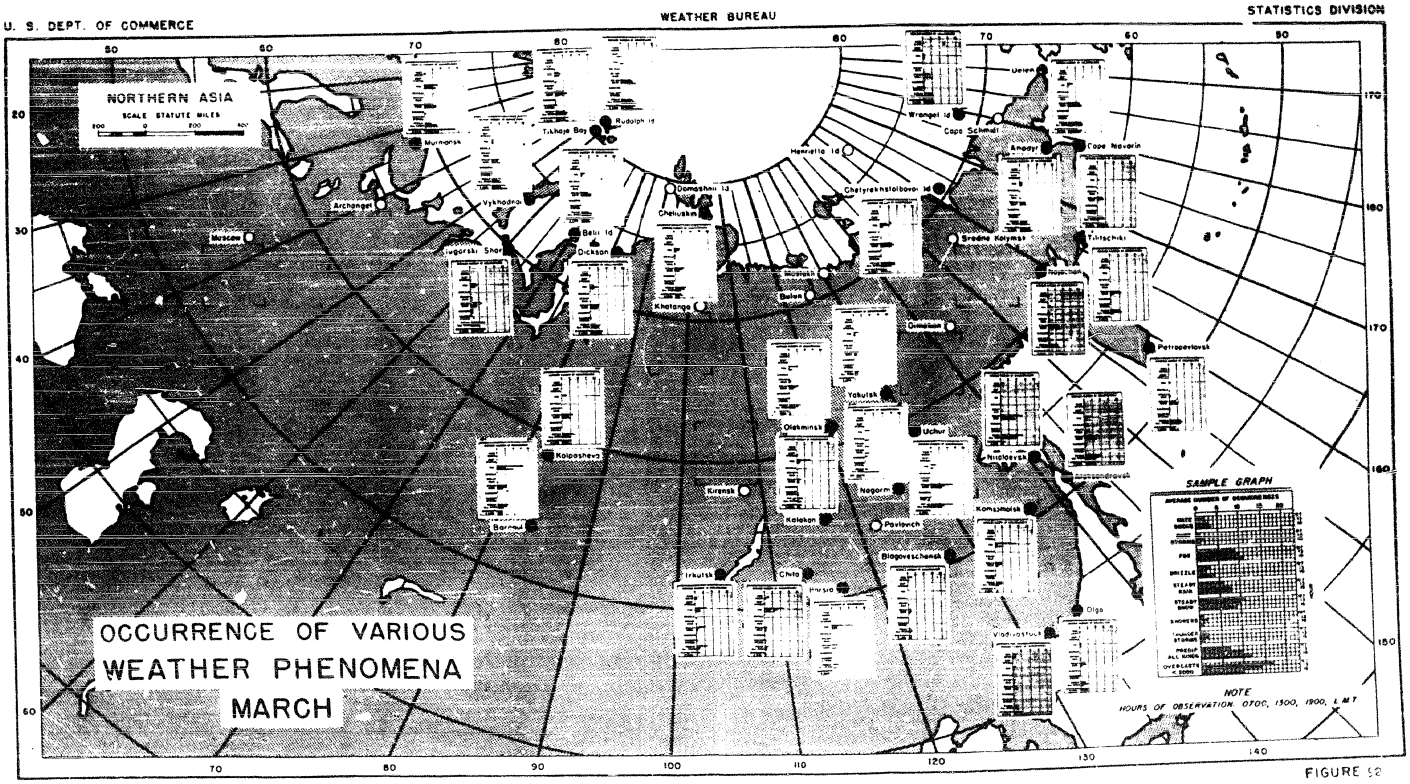
U. S. DEPT. OF COMMERCE — WEATHER BUREAU — STATISTICS DIVISION



FILE STAT 422212 — BASE STAT 422178-1 — FIGURE 52

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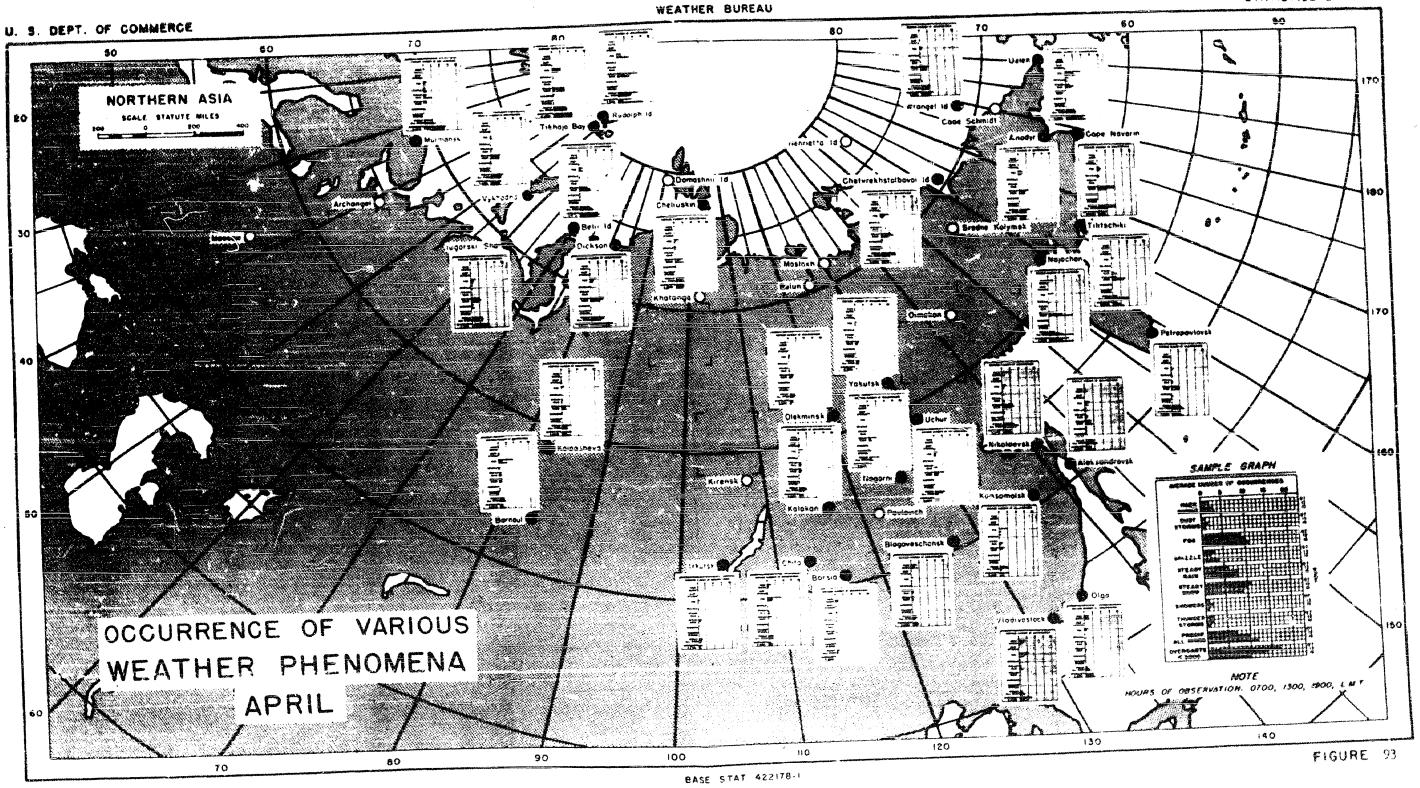

FIGURE 93

FILE STAT 422213

BASE STAT 422178-1

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U. S. DEPT. OF COMMERCE — WEATHER BUREAU — STATISTICS DIVISION

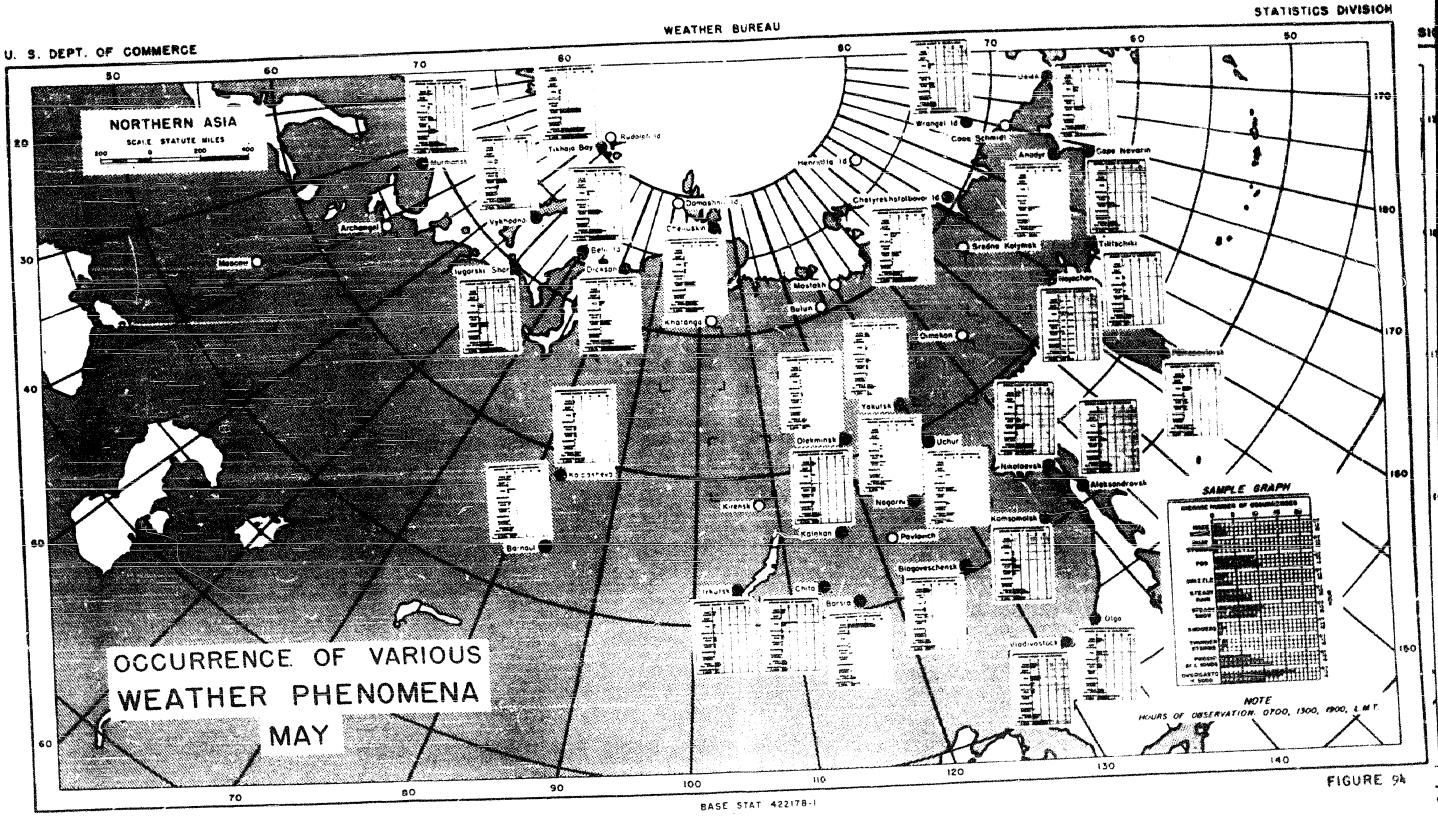

FIGURE 94

FILE STAT 422218

BASE STAT 422178-1

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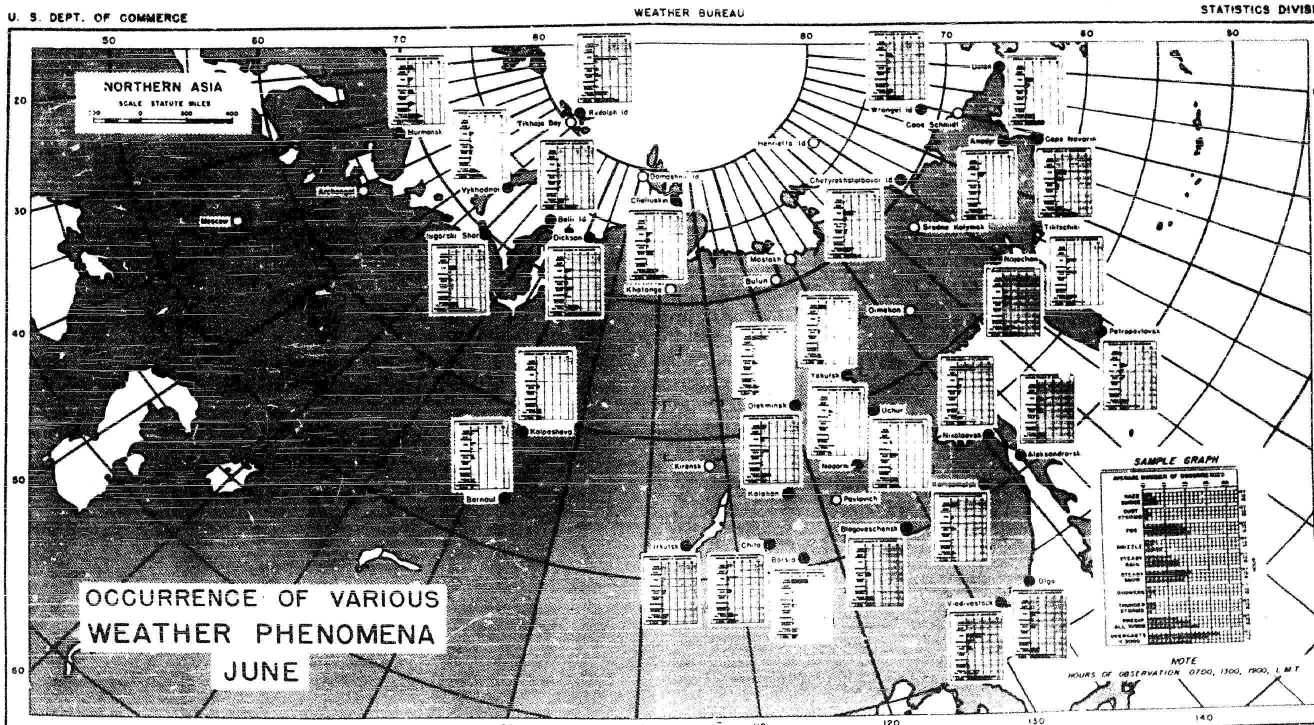
U. S. DEPT. OF COMMERCE WEATHER BUREAU STATISTICS DIVISI

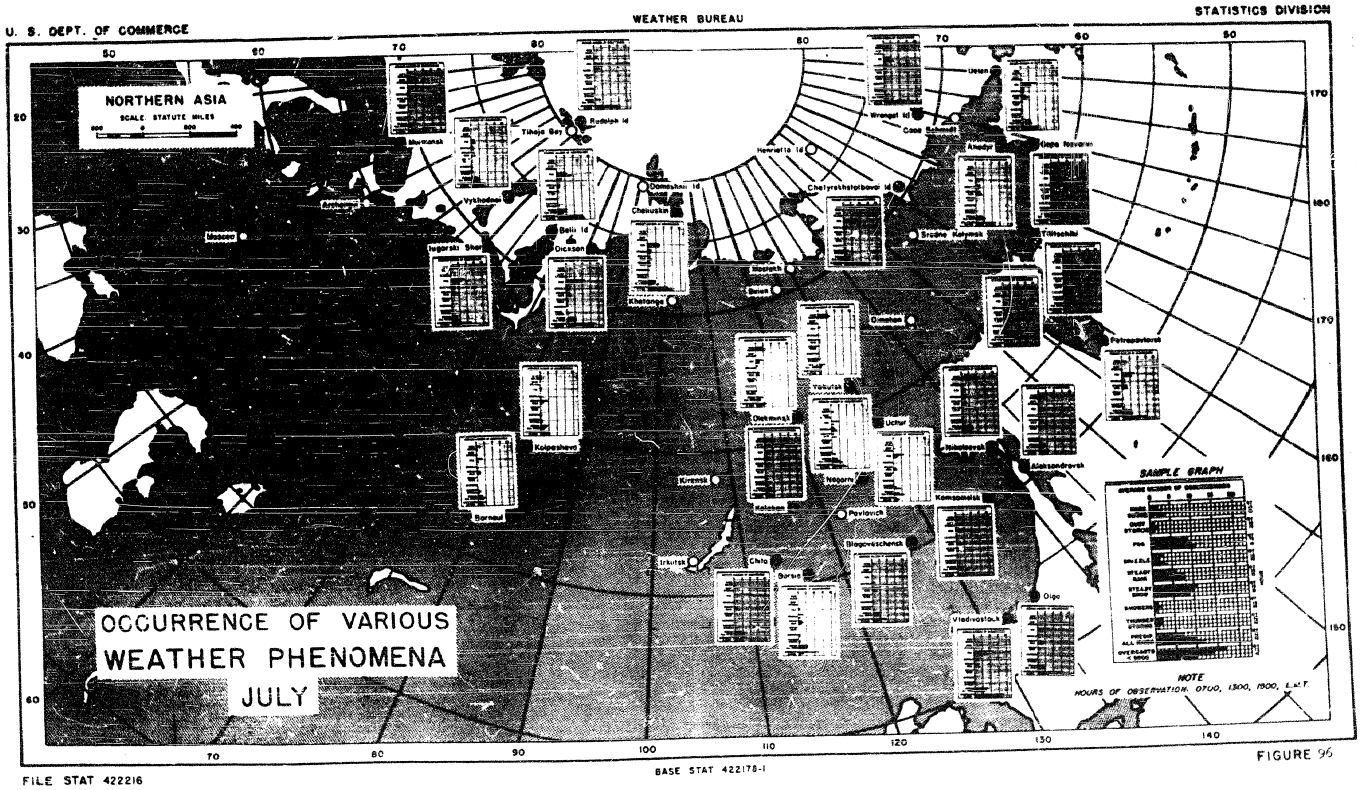


FILE STAT 422215 BASE STAT 422178-1 FIGURE

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2014/04/24 : CIA-RDP81-01043R003500090005-5

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2014/04/24 : CIA-RDP81-01043R003500090005-5

U. S. DEPT. OF COMMERCE — WEATHER BUREAU — STATISTICS DIVISION



FILE STAT 422216 — BASE STAT 422178-1 — FIGURE 96

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WEATHER BUREAU

STATISTICS DIVISION

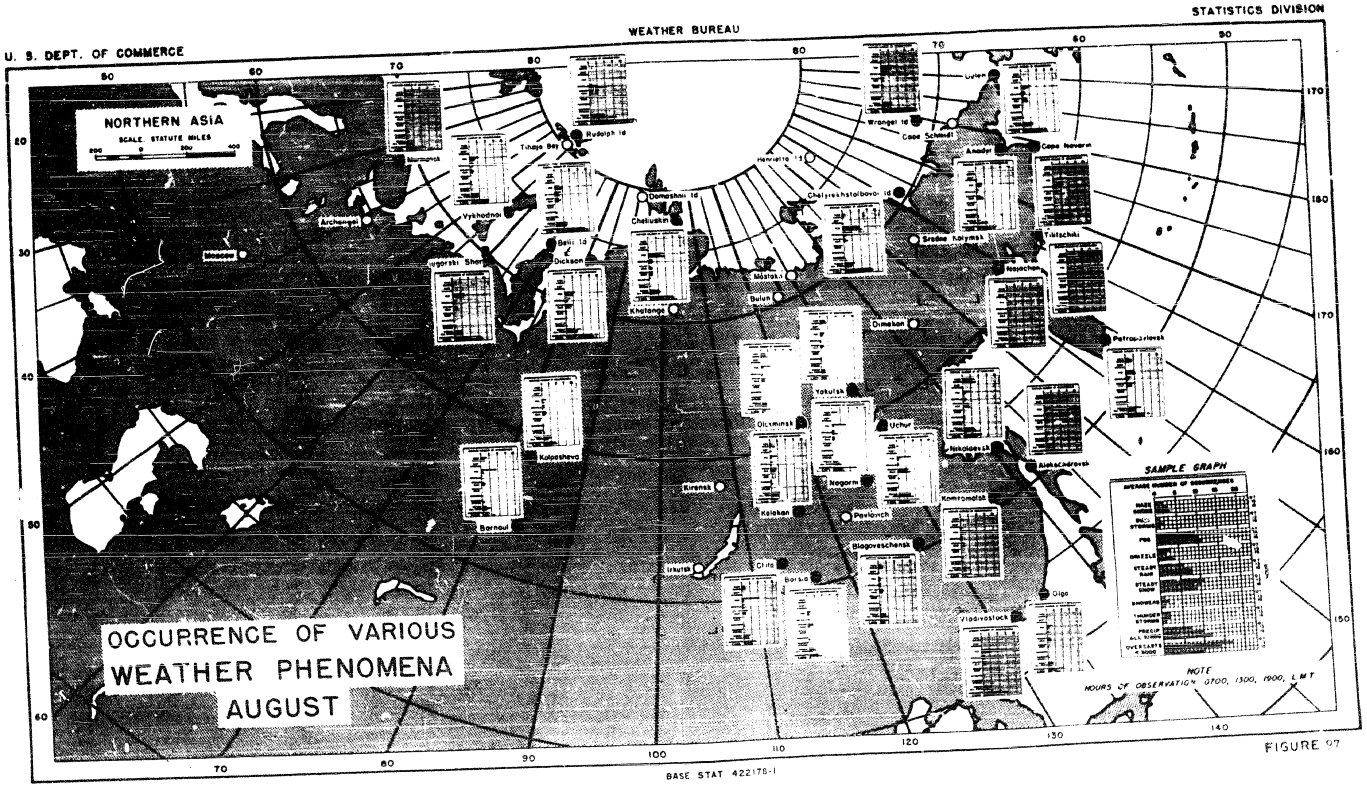

FIGURE 97

FILE STAT 422217

BASE STAT 422178-1

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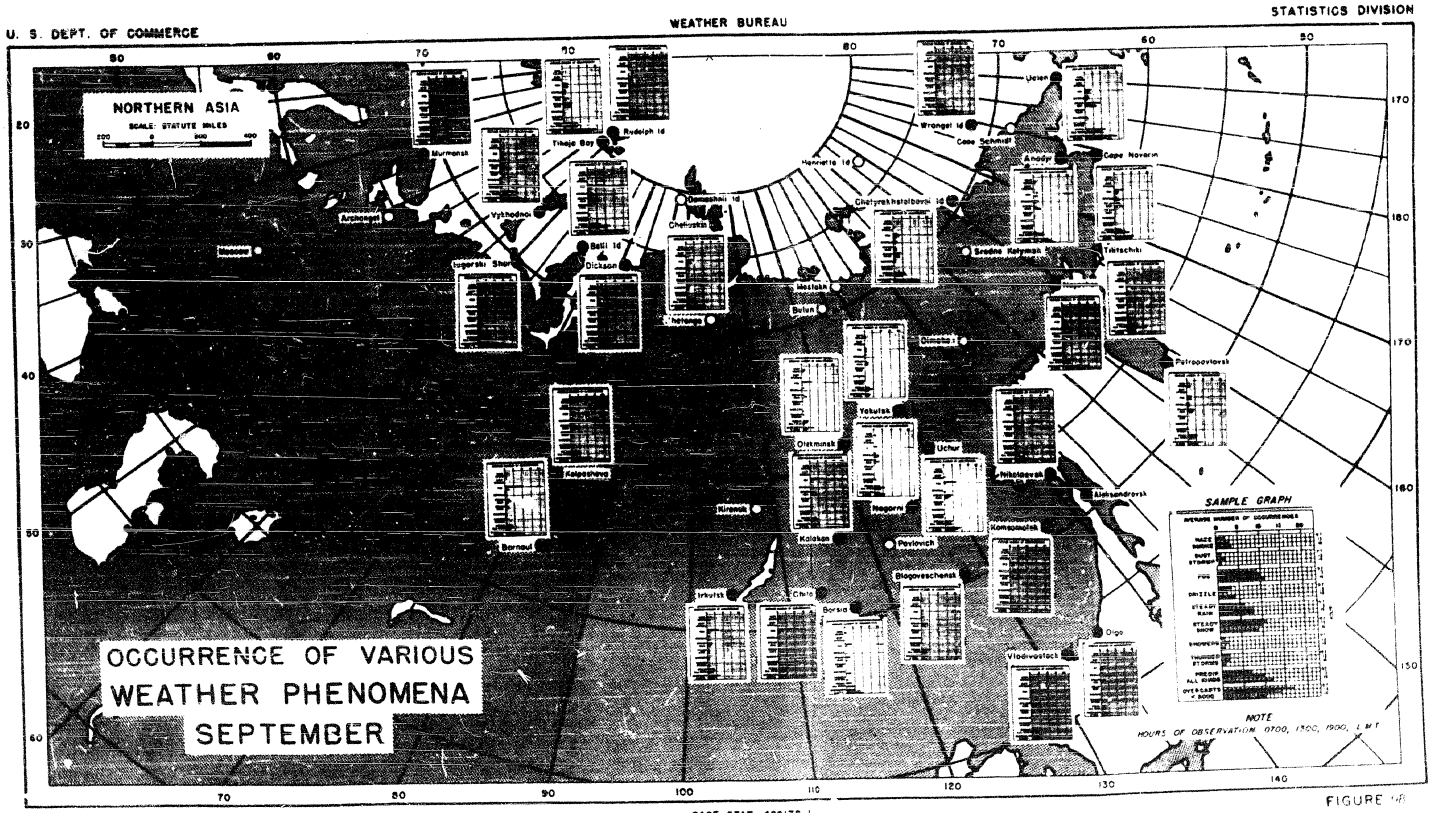
U. S. DEPT. OF COMMERCE — WEATHER BUREAU — STATISTICS DIVISION



FILE STAT 422218 — BASE STAT 422178-1 — FIGURE 18

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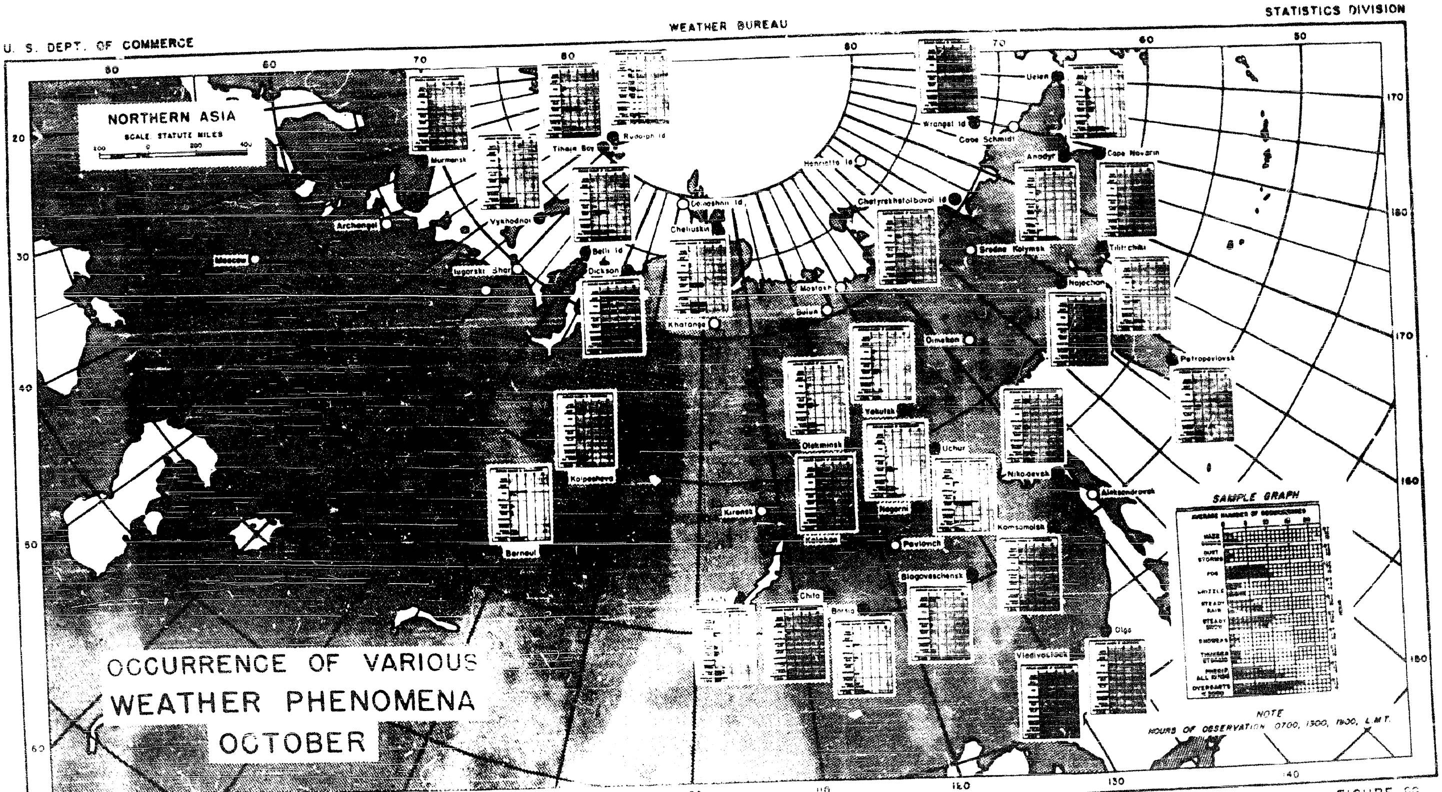

FIGURE 99

FILE STAT 472219

CASE STAT 472178.1

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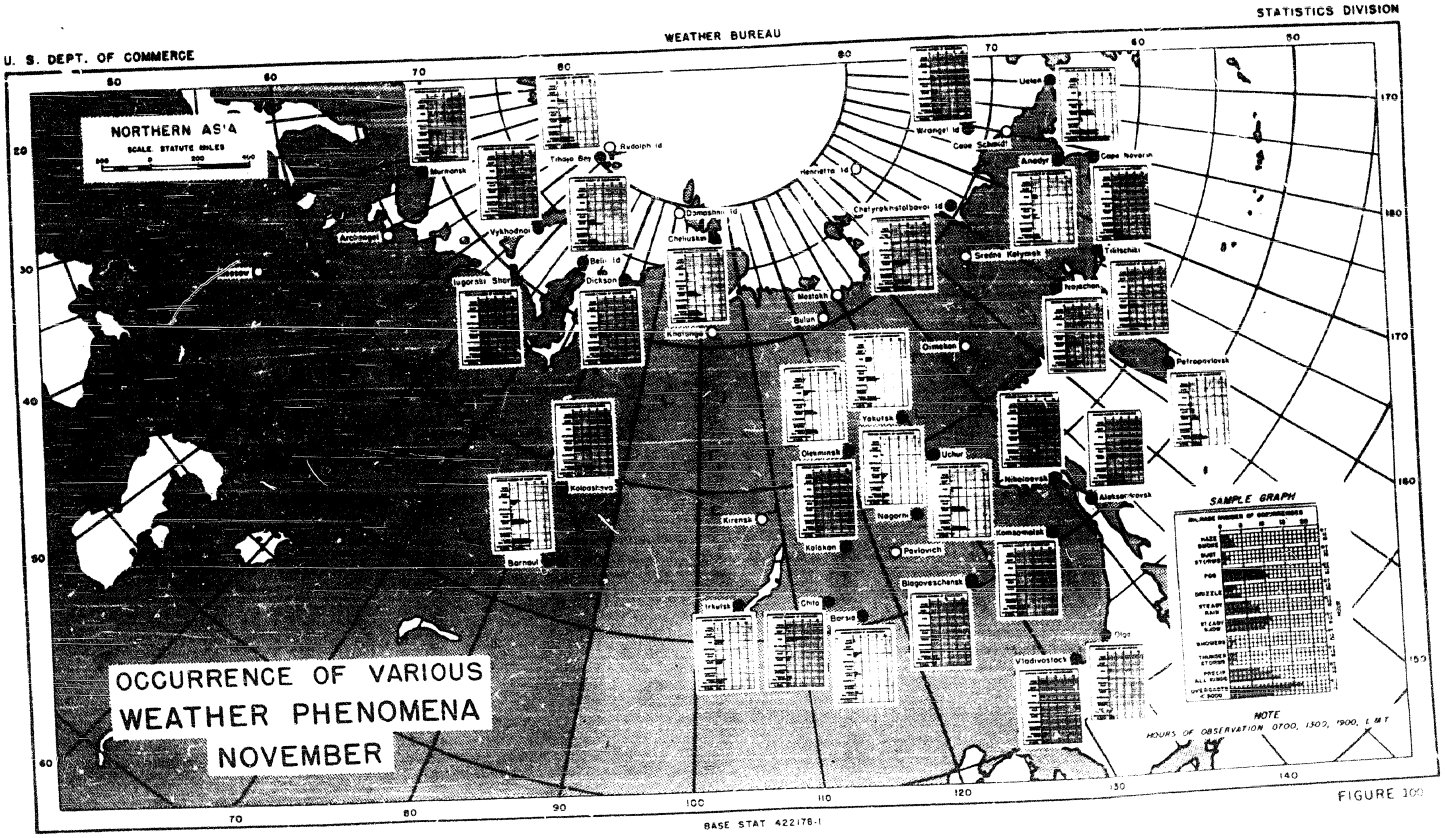

FIGURE 10

BASE STAT 422178-1

FILE STAT 422220

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U. S. DEPT. OF COMMERCE — WEATHER BUREAU — STATISTICS DIVISION

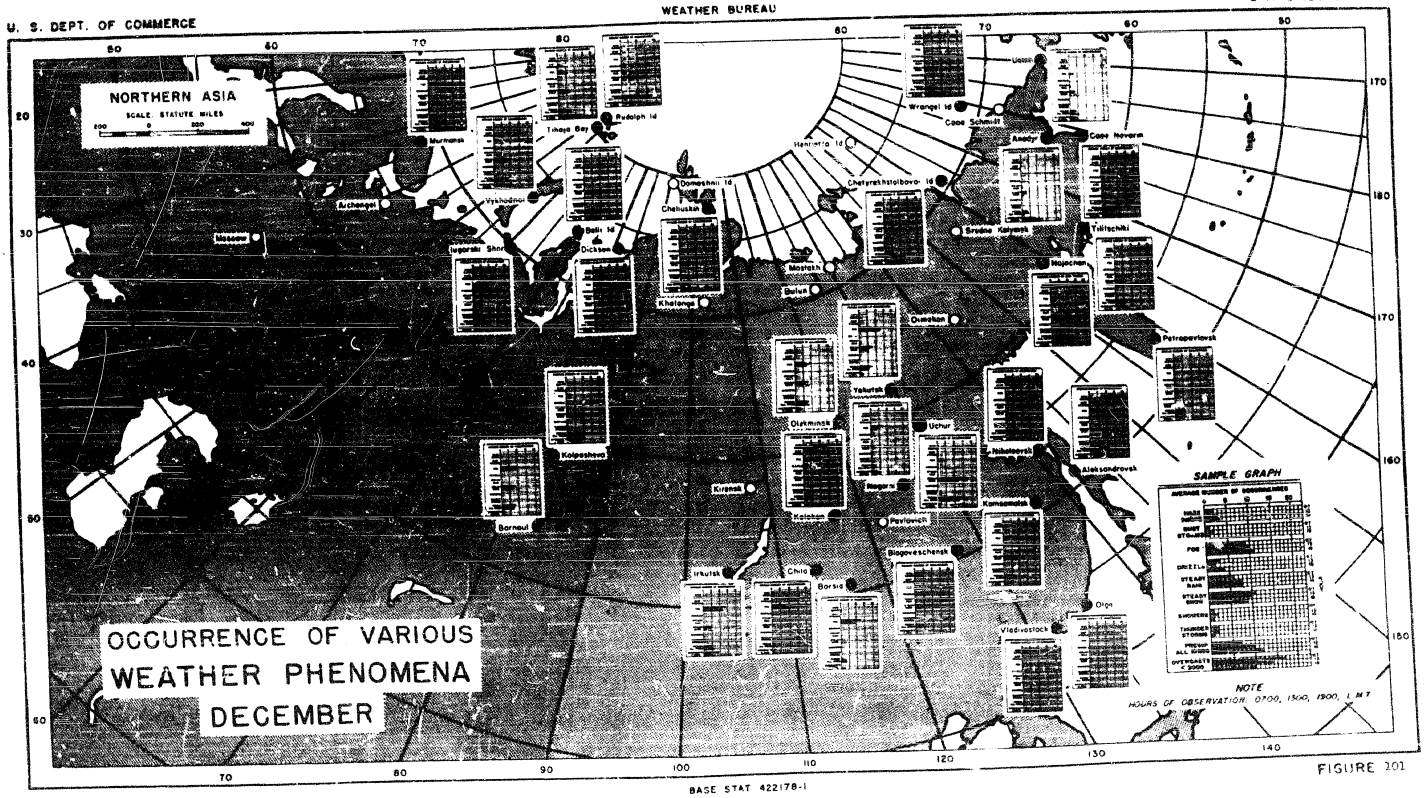

FIGURE 201

FILE STAT 422221

BASE STAT 422178-1

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